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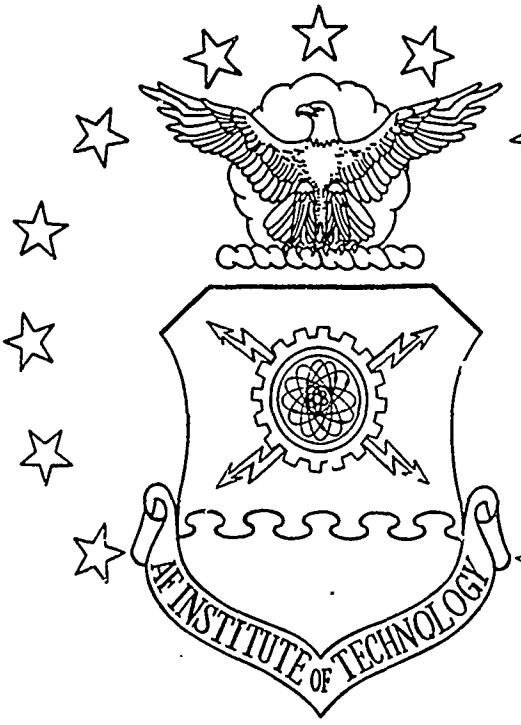

ENVIRONMENTAL EFFECTS UPON CROSS-SERVICING OF AIRCRAFT IN NATO

THESIS

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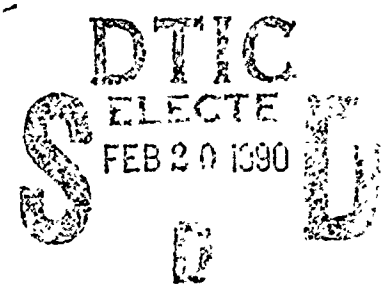

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THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Logistics Management

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LIEUTENANT COLONEL, SAF

December 1989

Acknowledgements

I would first of all like to express my appreciation to all the civilian and military personnel who participated in the Cross-servicing of Aircraft Survey. Without their participation, this study would never have been possible. Next, I would like to thank all the faculty body in the School of Systems and Logistics for the different courses received whose knowledge made it possible to develop this work. And last, but by no means least, I would like specially to thank my academic and theses advisor Dr. Craig M. Brandt who took over the extra burden of translating Spanish thoughts into English language. Nonetheless, I would like to recognize the silent help of my patient wife Pilar for her support and understanding through the endless revisions of this theses.

Juan A. del Castillo

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Abstract

Cross-servicing of aircraft within NATO is a system established to provide services to aircraft by organizations other than those to which the aircrafts are assigned. The ability to provide those services depends on the level of standardization and interoperability within the NATO alliance, and the present diversity of types of aircraft largely restricts the possibility to render those services. The system is regulated by the Standard Agreement 3430 under the field of responsibility of the Military Agency for Standardization (MAS).

New factors in the NATO political, economic, and military environment have arisen in the last few years, which added to already existing factors, have produced a situation of increased force requirements with reduced defense budgets and are forcing NATO planners to reassess the whole strategic planning within the alliance.

To determine the effects of the new environmental factors on the NATO logistics situation, thus on the diversity of types of aircraft and cross-servicing capabilities, a survey package was sent to the several organizations involved in the management of logistics throughout the alliance. The survey answers were statistically analyzed for homogeneit by regional areas, by continent, by organization, ar e

condition of civilian or military of the respondents. The results were then summarized as conclusions for the research topic, but in the cases where the homogeneity tests were rejected this lack of homogeneity was a conclusion in itself as a causal factor explanatory for the lack of agreement responsible for the present situation of cross-servicing within the NATO alliance.

A new situation has evolved which is forcing NATO countries toward cooperation with renewed strength whose results are going to emerge during the years to come.

ENVIRONMENTAL EFFECTS UPON CROSS-SERVICING OF AIRCRAFT IN NATO

I. Introduction

Chapter Overview

This chapter begins with a description of the changes in the NATO strategic environment which, when added to already existing environmental factors, lead to the specific problem of increased force requirements while faced with reduced defense budgets. This will have an impact upon NATO logistics situation, thus upon cross-servicing of aircraft, which is the focus of this thesis. This chapter presents the background to the problem, problem statement, and research objectives. Finally, the scope and limitations, and assumptions will complete the chapter.

General Issue

Cross-servicing of aircraft within NATO is the servicing performed on an aircraft by an organization other than that to which the aircraft is assigned, according to an established operational aircraft cross-servicing requirement, and for which there may be a charge (32:A-1). Aircraft cross-servicing has been divided into two categories. Stage A calls for refueling only. Stage B includes refueling, rearming, and film reloacing, with the aircraft then tasked for another

sortie (32:A-1, 39:79). The ability to provide this servicing depends on the level of RSI (Rationalization, Standardization, and Interoperability) among the air forces of the NATO member countries. As stated in (28:37), the four keys to successful coalition warfare are: (1) unity of command; (2) standardization; (3) interoperability; and (4) sustainability. The diversity of aircraft largely precludes efficient interoperability, thus the operational capability of the NATO air forces.

With the signing of the INF Treaty, the conventional arms gap between NATO and the Warsaw Pact becomes increasingly important in NATO strategy (21:78). One result of this gap is the increased task requirements for the armed forces of the NATO member countries. The effects of Perestroika and Glasnost on western public opinion, coupled with the increased terrorist activity, might put NATO countries in a situation of increased force requirements and reduced defense budgets. As pointed out by Anthony Cordesman, adjunct professor in the National Studies Program at Georgetown University, "The greatest threat facing NATO in the next years will be the good intentions of the determinedly uninformed" (27:17). They believe that Perestroika and Glasnost will eliminate the threat, thus the need for defense expenditures. Besides, the rising weapon system development costs will make the problem even worse (8:105). This new environment is pictured in Figure 1. Under these circumstances, the most

efficient use of the available resources through RSI will become vital. Collective security depends upon greater integration of military requirements with defense-industrial cooperation and economic-political interface alliance-wide.

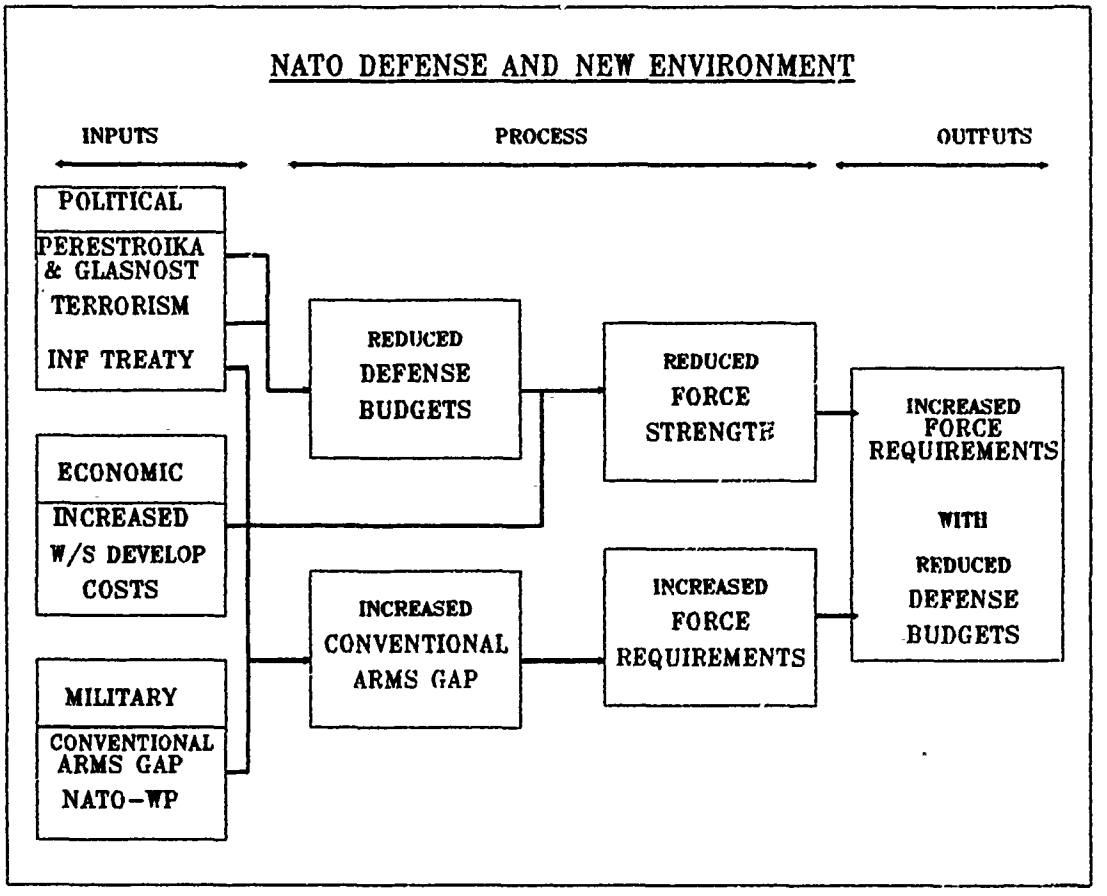

Figure 1. NATO Defense and Environment

Although several aircraft in NATO are the result of collaborative projects, the Alliance has still about 23 different kinds of fighter aircraft (21:78) and, because of their sophisticated technology, the task of standardization is difficult and lengthy, as showed by the more than 175

STANAGs related to NATO aircraft (35:101). However, in spite of this standardizing effort, very little can be done once the aircraft project has left the design phase. "Interoperability is what we do with the mess we have. Standardization is what we do to avoid having a mess in the future" (9:136). Within the allied air forces' field of responsibility on RSI, one major achievement is the aircraft cross-servicing system in operation in NATO (STANAG 3430) (Figure 2).

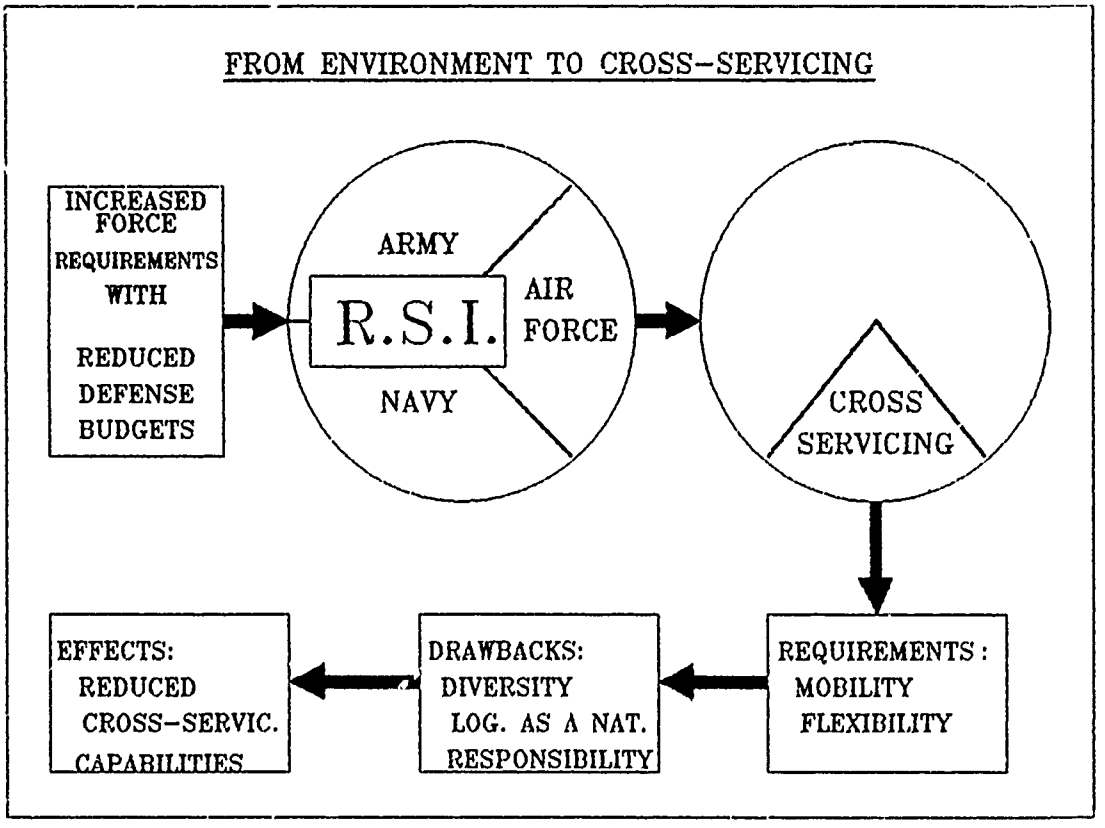

Figure 2. From Environment to Cross-servicing

The cross-servicing system allows the aircraft of one alliance member country to receive servicing from another

country. This possibility is largely limited by the different technical equipment required. The system renders information about which airfield can provide servicing and other facilities to which specified aircraft, by means of two status reports published by Allied Command Europe (ACE) and Supreme Allied Commander Atlantic (SACLANT) (35:102).

The cross-servicing system is complemented by the Mutual Emergency Supply Support system in the areas of procurement and supply. The MESS Memorandum of Understanding (MOU) allows the air forces of one NATO member country to ask the others for supply support in case of emergency. It is also required whenever the criticality of key items may endanger aircraft readiness. The system is a mechanism available for the redistribution of stocks during wartime. However, the capability to support with supplies is largely limited by the level of interoperability among the NATO air forces.

Background

The different organizations involved in the management of the chain of concepts that begins on the top by RSI and ends in cross-servicing can be grouped into five general categories or levels, which correspond to the air forces, the Departments of Defense, the allied organizations in NATO, the European non NATO logistic organizations, and the aeronautical industries.

The Air Forces. The air forces are responsible for, and the principal operational organizations taking full benefit

of, the levels of interoperability which allow or arrest cross-servicing capabilities. The air forces of the NATO member countries begin the procurement process, under Phased Armaments Programming System (PAPS), by stating a Mission Need Document (MND), which when agreed upon becomes a ONST (Outline NATO Staff Target). Then a NATO Staff Target (NST) is developed, and the process ends by defining the weapon system specification requirements or NATO Staff Requirements (NSR) (15:3-9) beginning the Full Scale Development phase. At this early stage cooperative programs may achieve a high level of standardization without having to sacrifice too many basic operational requirements. A tight configuration control must be kept, though, throughout the service life of the weapon system to ensure that the initial interoperability level is maintained.

The possibility to provide effective cross-servicing of aircraft among the alliance member countries is a key factor in the feasibility of the reinforcement plans, specially if they are to be implemented in a degraded crisis or wartime environment (27:16).

The Departments of Defense. The Departments of Defense are responsible for the critical interface among the pure military needs and the economical and political constraints arising from the aeronautical industries. The DODs are normally the decision-making levels in all the matters concerned with major weapon system acquisitions, and because of

this, around them converge all the pressures upcoming from the different parties interested in the process.

The Allied Organizations in NATO. The logistics function within the Alliance is divided into its two main subfunctions, production logistics and consumer logistics (35:19):

Production Logistics. (Figure 3) The Conference of National Armaments Directors (CNAD), subordinate to the North Atlantic Council (NAC), is responsible for promoting the development of cooperative programs to increase standardization and interoperability among the NATO member countries. Directly depending from the CNAD are the NATO Industrial Advisory Group (NIAG) and the NATO Air Force Armament Group (NAFAG). The standard operating procedures for fostering the development of cooperative production programs are the

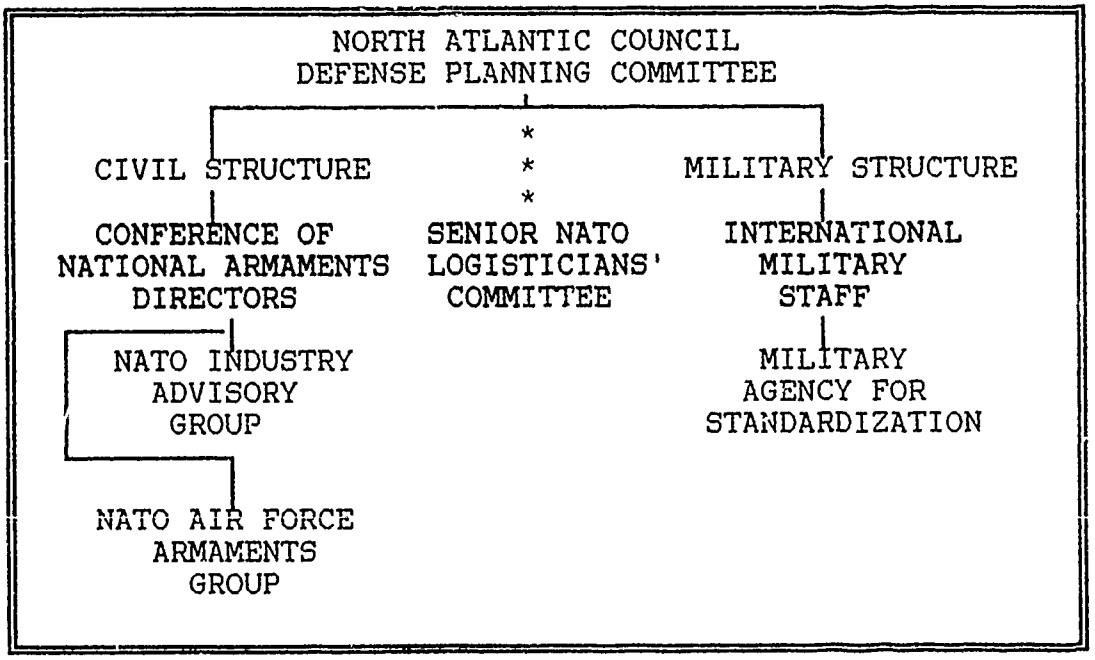

Figure 3. NATO Logistics

Phased Armaments Programming System (PAPS) based upon agreed staff requirements to identify alliance mission needs, and the NATO Armaments Planning Review (NAPR), a process which includes annual national submissions to NATO on equipment replacement schedules for major systems (35:55).

Consumer Logistics. The Senior NATO Logisticians' Committee is the principal committee for consumer logistics and is responsible for coordinating the organization, plans, procedures and capabilities of alliance forces (35:41).

The Military Agency for Standardization (MAS) is the principal military agency for standardization, and its purpose is to promote the procedures and material standardization of NATO forces. It is directly responsible for the management of the Standardization Agreements (STANAG) (35:72).

The European Non-NATO Logistics Organizations. These are organizations involved in the defense effort to obtain the best results from the available resources, in the European context, outside the NATO alliance.

Western European Union (WEU). The chartered objective of the WEU is to foster the integration of the European part of NATO in security matters, but to focus more on the assumption of responsibilities specifically European than on excluding other NATO members from its activities. The same matters are under the responsibility of the corresponding NATO organizations at a higher level, and the non-European NATO members are invited to attend the WEU meetings (35:35).

FINABEL. It is a logistics organization equivalent to the CNAD in NATO, established to incorporate the otherwise missing important inputs from France into the NATO armaments planning structure (35:35).

EUROGROUP. It is an organism which provides an informal, non-binding forum where the NATO European member countries exchange defense information. EUROGROUP was created to foster European countries contribution to the common defense of the NATO alliance (34:63).

EUROLOG is EUROGROUP's logistics branch, and EAIRSG (EUROLOG AIR SUBGROUP), as a delegate body, is the committee directly responsible for planning, organizing, and updating, the cross-servicing of aircraft within NATO Europe. Nevertheless, resolutions achieved at EUROLOG's meetings must be sent to the MAS for implementation (35:35).

EUROLONGTERM is the committee chartered with the analysis of long-term alliance strategic concepts and the development of the estimated force requirements to meet the changes in the strategic situation. It is the consulting group where the Mission Need Documents (MND) and related documents are actually coordinated among the NATO member countries to be elevated to the CNAD (35:36).

Independent European Program Group (IEPG). Independent of NATO and EUROGROUP, this organization is the principal forum for co-operation in procurement of armaments among the European NATO member countries, included France,

but without Iceland (35:37). The IEPG seeks to foster the cooperation within the European Community with the following goals (11:3).

. Strengthen the contribution of the European allies to the common defense of the NATO alliance.

. Improve the European technology base.

. Balance US-European defense trade.

The Aerospace Industry. (Figure 4) The aerospace industries can be grouped in three layers, corresponding to: 1. the major airframe manufacturers and assemblers; 2. the

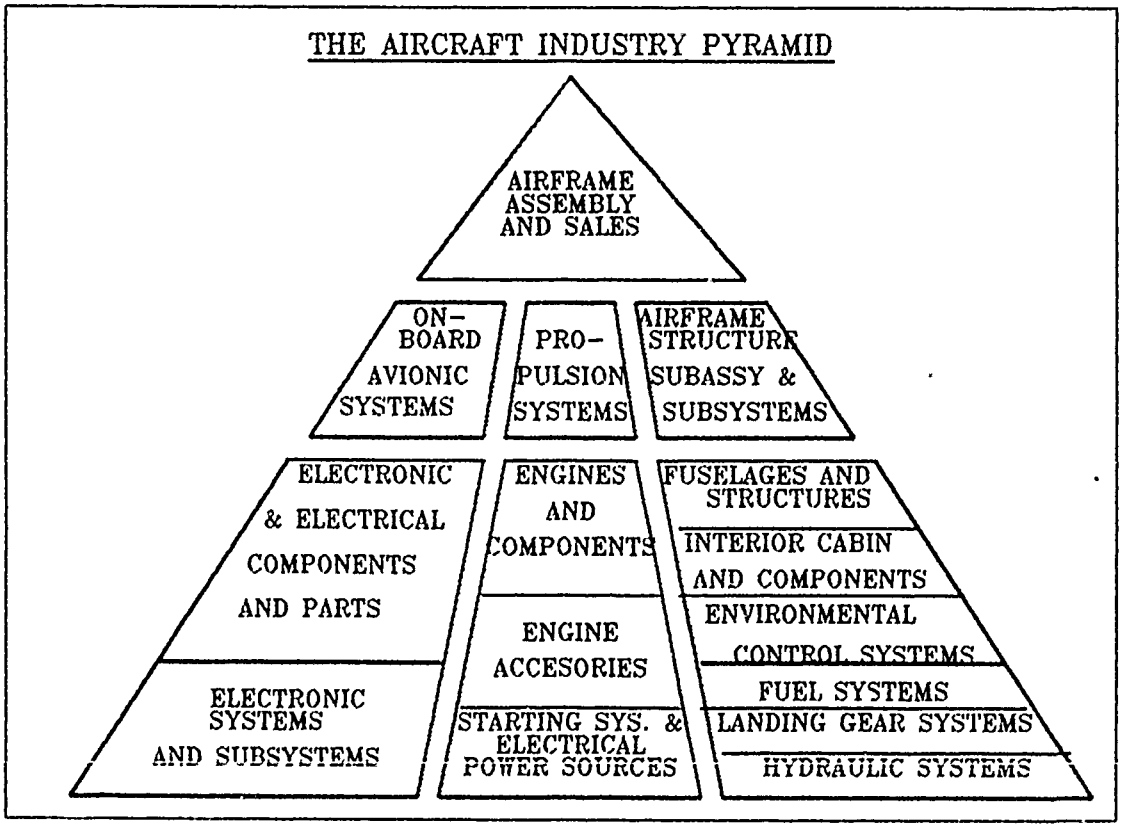

Figure 4. The Aircraft Industry Pyramid

major systems manufacturers and assemblers; and 3. the aircraft parts and auxiliary equipment manufacturers (1:48).

The aeronautical industry experiences an international situation of production capacity in excess of demand. Besides, the ever growing development costs and risks, increased possibilities for access to advanced technology, absence of significant product differentiation, and access to market share, are all conditions leading toward the increase in joint venture. Their advantages are possible expansion of markets; possibility of recouping R & D investment through exports; creation of jobs; establishment of a positive balance of trade; strengthening of national technology bases; support to high technology and defense industries (1:52).

On the other hand, the disadvantages are the technology transfer for the more advanced companies; lose of self-sufficiency in arms production capabilities; overemphasis on offsets; and complexity of the collaboration itself (1:52).

According to one among several classifications the multiple diversity of arms collaboration approaches can be grouped into six general categories: (Figure 5).

Codevelopment is a program based on a government-to-government agreement in which the industries of two or more countries take part in the development of a weapon system for which participating countries share cost; i.e. NATO frigate.

Coproduction is a program based on a government-to-government agreement in which the industries of two or more coun-

tries take part in the production of a weapon system that is being acquired by all of them; i.e. AV-8B Harrier.

Opening defense markets depends on a reciprocal Memorandum of Understanding (MOU). In essence, each country looks at its requirements and products to satisfy them. If an acceptable match is found between the requirement and equipment, then the needed item is acquired from the source; i.e. 9mm Beretta pistol.

Packages is a new concept in which a variety of collaboration approaches may be used. It is done by government-to-government, industry-to-industry, and industry-to-government

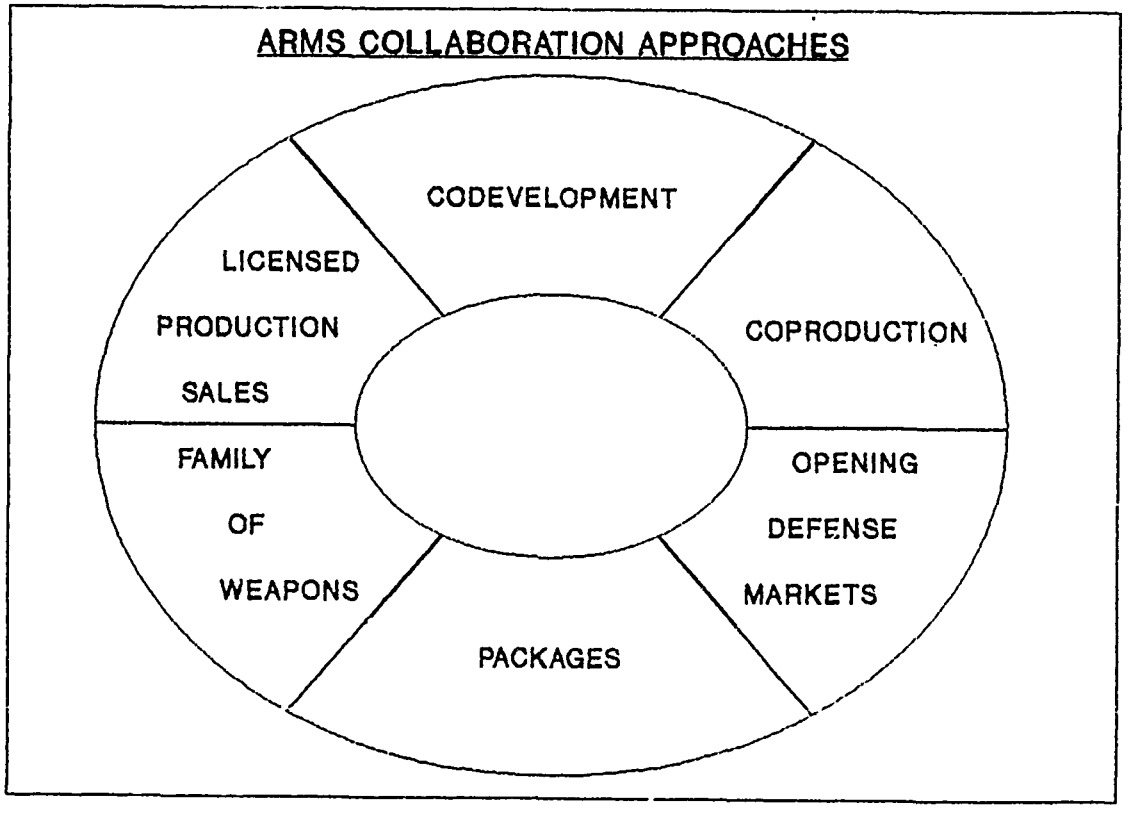

Figure 5. Arms Collaboration Approaches

agreements. Each party shares in a piece of the economical pie through packaging, thus avoiding any offset requests; i.e. US-FRG Patriot-Roland agreement (Figure 5)(15:2-10).

Family of Weapons involves the creation of families of weapons for systems not yet developed. Participating nations would reach early agreement on responsibility for developing complementary weapon systems. The approach is to examine the weapons that nations plan to develop in the next few years, aggregate them by 'mission area,' and then coordinate the development of equipment when feasible; i.e. AMRAAM/ASRAAM. (15:2-10).

Licensed Production can be considered a subset of coproduction. LP is a term used to indicate production by a non developing source that is specifically authorized by a license from, or right granted by, the developing source or other party with disposal rights to the requisite intellectual property ; i.e. Japan's F-104 fighter.

The characteristics, advantages, and disadvantages of the different cooperation approaches are summarized in Figure 6 (15:2-16).

The General Problem Environment. When NATO was created in 1949 most of the European industry was destroyed, and during most of the 1950s and 1960s, the U.S was almost the exclusive source of procurement for military equipment. Thus, today's RSI was not a main concern for the alliance. But the resurgence of European industry produced an increasing number of different types of weapon systems. The costs

LICENSE PRODUCTION GOVT-TO-GOVT INDUSTRY-INDUSTRY MINIMIZE R&D BEST TECHNOLOGY RESTRICTED TO OWN USE SHARED INDUSTRIAL BENEFIT RAPID FIELDING STANDARDIZATION	CODEVELOPMENT GOVT-TO GOVT TECHNOLOGY SHARING BEST TECHNOLOGY COST-SHARING WORK-SHARING HIGH QUALITY TEAM INT'L PROGRAM MGMT WORK AS PARTNERSHIP TAKES LONGER HIGHER COST STANDARDIZATION	COPRODUCTION GOVT-TO-GOVT MINIMIZE R&D R&D RECOUPMENT BEST TECHNOLOGY RESTRICT THIRD PARTY SALES SHARED INDUSTRY BENEFIT ASSURED SECOND SOURCE COULD BROADEN COMPETITION
FAMILY OF WEAPONS GOVT-TO-GOVT NON-DUPLICATIVE R&D TECHNOLOGY SHARING SHARED INDUSTRIAL BENEFIT STANDARDIZATION	PACKAGES GOVT-TO-GOVT INDUSTRY-INDUSTRY NO R&D RAPID FIELDING LOGISTICS BASE MEETS MULTIPLE DEMANDS (DEFENSE, OFFSET,JOBS) STANDARDIZATION	OPENING DEFENSE MARKETS NO R&D PROVEN SYSTEM RAPID FIELDING DIRECT PURCHASE PRODUCTION ECONOMICS LOGISTICS BASE STANDARDIZATION

Figure 6. Cooperative Programs

incurred in the development and production of weapon systems steadily grew up, and because of the waste and duplication of defense effort, regardless of the larger investments in defense, the alliance has not matched the Warsaw Pact in the total force strength achieved (37:155).

The different industrial-commercial procedures, established for the development of joint ventures in the aeronautical industry, have produced relative improvements in RSI, affecting only the parts involved in the enterprise, while the existing diversity still limits seriously the most effective use of allied air forces' mobility and flexibility.

Cross-servicing Status. Cross-servicing of aircraft, as a fundamental part of RSI, has not achieved the desired level to allow the efficient integration of allied air forces in the NATO command structure, despite the continuous standardizing efforts of MAS and other NATO bodies (16:12-264).

As depicted in Figure 7, the cross-servicing regulation within NATO is directed toward the 'qualitative,' selective capability to provide servicing to some visiting aircraft by some receiving units, both in the international cross-servicing combined planning and national inter/intra-services cross-servicing planning as an extension of the jointness concept which requires closely coordinated and mutually supporting operations by air, land and sea forces (24:19-24).

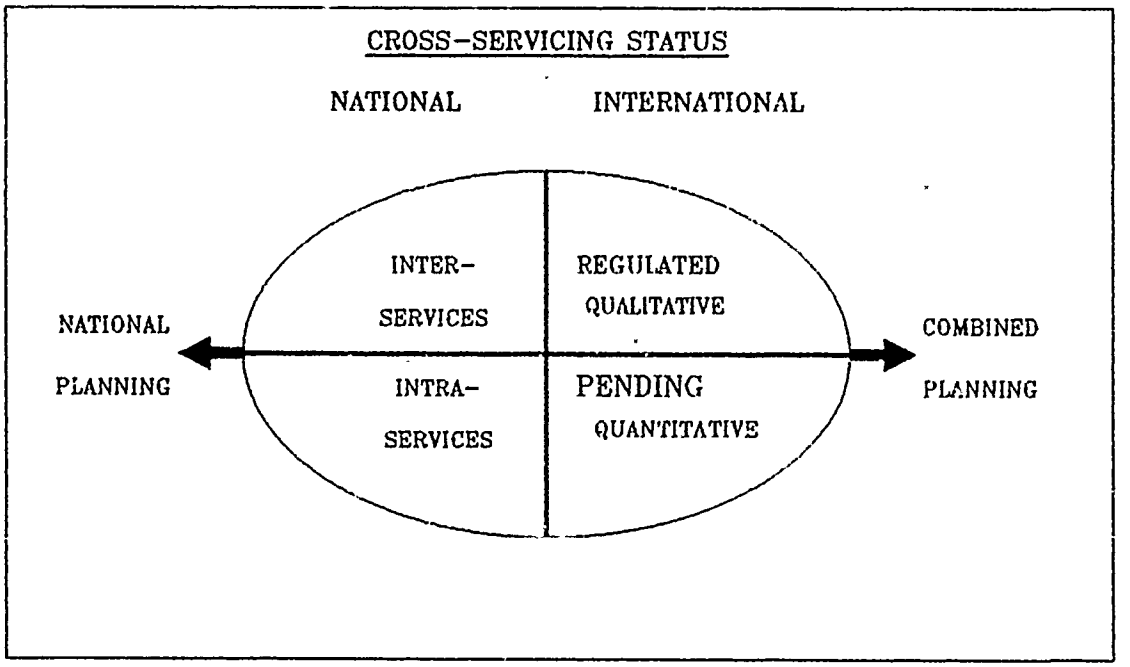

Figure 7. Cross-Servicing Status

The 'quantitative' assessment of cross-servicing capabilities, in terms of resources and coordination required, is pending of regulation and development, as an essential factor in the combined or joint air operations planning processes. Thanks to the cross-servicing guides, it is possible nowadays to say which aircraft can be serviced at which airfields. However, neither the system to quantify the resources the visiting unit has to carry with nor the effects that deployed operations would have upon receiving units are regulated yet.

The diverse components included in the two stages of cross-servicing capabilities (see definition) can be divided into personnel training and availability; weapon system interoperability, including the aircraft, its equipments and armament; the ground support equipment; and the MESS supply support; and finally facilities interoperability (Figure 3).

Material related characteristics, early decided in the weapon system development process, largely determine the future cross-servicing capabilities throughout the weapon system life. The NATO Mutual Support Act (NMSA) allows two forms of cross-servicing. The NMSA authorizes the interchange of logistic support, supplies, and services among governments of NATO countries, and NATO subsidiary bodies. The NMSA also provides an umbrella for the negotiation of bilateral or multilateral cross-servicing agreements. The payment for the services or supplies can be done by cash or by Replacement-in-Kind (RIK), which refers to the exchange for other

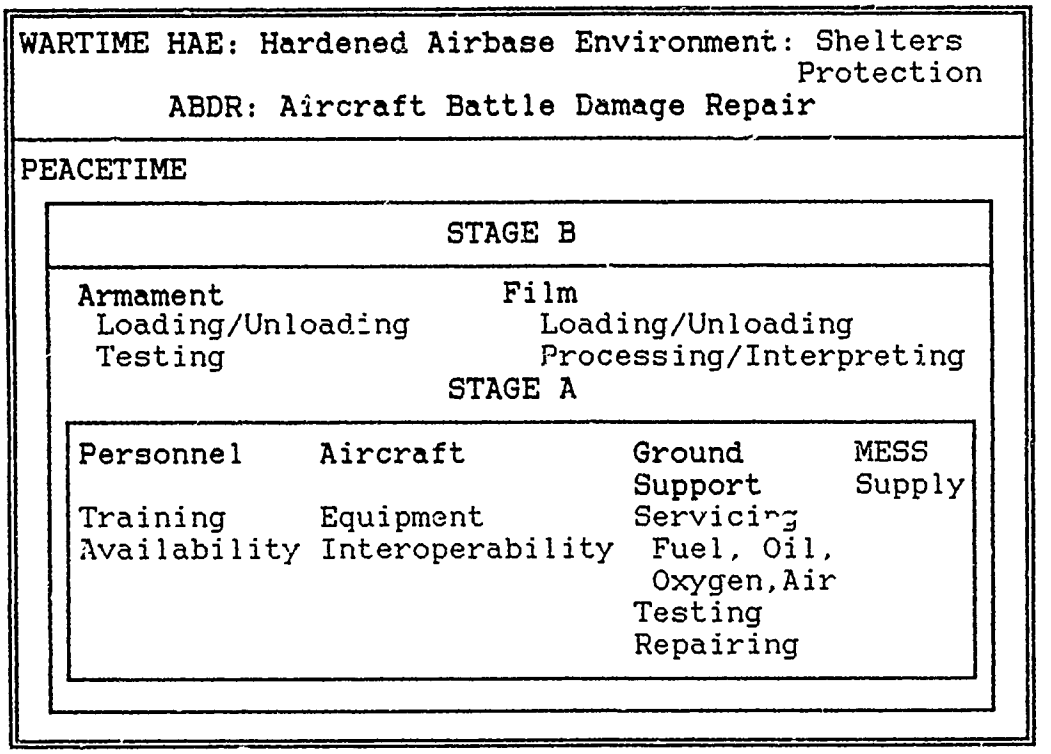

Figure 8. Cross-Servicing Components

equivalent supplies or services. This equivalence is normally understood as an item with the same part number and a similar life time to be accepted by the receiving country (15: 16-25).

Specific Problem

What will be the effects of the new military, political, and economic environment upon the cross-servicing of aircraft within the NATO Alliance? Under the increased conventional force strength requirements, reduced military budgets, and confluence of different interests, will the defense procurement process evolve toward higher levels of cooperation, thus improved RSI and cross-servicing capabilities, or else toward

output, what will be the result of the new forces added to the already existing environmental factors?

Research Objectives/Investigative Questions

The purpose of this research is to identify within the several decision making organs related with the procurement of weapon systems the relative importance of the factors affecting the capabilities for cross-servicing of aircraft within the NATO alliance. Then the causes and consequences of the preceding factors upon the cross-servicing problem will be addressed; and finally, the most likely solutions for the problem will be explored.

1. Is there a real perception of RSI and cross-servicing as a major problem in NATO with regard to the new environment?

a. What is the perceived relative strength of the different environment factors affecting RSI and the cross-servicing of aircraft?

b. What are the effects of the above factors upon the NATO logistics situation?

c. Does this situation really translate into a genuine problem?

2. What are the causes underlying the present diversity of aircraft within the NATO Alliance?

a. What is the relative strength of political, economic, and military causes?

b. Which organizations are believed to be responsible for the cross-servicing problem?

3. What are the logistics areas upon which the cross-servicing deficiencies have a more decisive impact in peacetime and wartime?

a. Which logistics areas are the most affected by the cross-servicing deficiencies?

b. Which cross-servicing subsystems would receive the most benefits from the correction of cross-servicing deficiencies?

4. What are the most likely solutions for the cross-servicing problem?

a. Which cross-servicing subsystems represent the best opportunity for improved Standardization and Interoperability?

b. What is the role that NATO organizations have to play to solve the cross-servicing problem?

c. What is the relative importance of the different cooperative programs in order to help solve the problem of diversity of weapon systems within NATO?

d. Which is/are the level/s of aeronautical industry which most likely has/have to modify or redirect its production to cope with the contraction of defense markets?

Assumptions

The following assumptions have been used with regard to the research problem:

1. There is a direct relationship between the level of RSI and the cross-servicing capabilities.

2. The data collected will represent the respondent's personal opinions, instead of the stated official policy about the investigative questions in the different decision-making organizations within the NATO alliance, in an attempt to uncover the reasons for the present diversity of armaments in spite of the general official agreement on RSI benefits.

3. The trend in the aeronautical industrial sector will be determined by the agreement among the different parts involved in the decision-making process, so that the mean/mode values of the variables could be considered an indication of trend.

4.There are no significant differences in either the organizational or national commitments toward the common defense, so that the different positions are directly comparable.

Scope and Limitations

Scope. The NATO cross-servicing concept will be covered as an integral part of RSI, including the activities detailed in the definition. It will include the fourteen NATO nations (Iceland and Luxembourg excluded, as they do not keep active armed forces), regardless of their particular membership characteristics. The consequences of the new environment in the NATO logistics area of cross-servicing will be extended to the related aerospace industry organizations in the NATO

countries. To close the loop, there will be an estimate of the trend for aeronautical industries as they adapt to the new circumstances.

Limitations. The topic will be limited in concept to the identification of the relative importance of the factors that determine cross-servicing capabilities. With regard to the geographic area, the topic will be limited to the NATO member countries. Civilian as well as military organizations will be covered.

Definitions

Aircraft Cross-Servicing: services performed on an aircraft by an organization other than that to which the aircraft is assigned, according to an established operational aircraft cross-servicing requirement, and for which there may be a charge. Aircraft cross-servicing has been divided into two categories (32:A-1).

Stage A Cross-Servicing: the servicing of aircraft on airfields/ships, which enables flights to be made to another airfield/ship. The servicing includes refuelling, replenishment of fluids and gases, drag chutes (if applicable), starting facilities, and ground handling (32:A-1).

Stage B Cross-Servicing: the servicing of an aircraft on airfields/ships which enables the aircraft to be flown on an operational mission. The servicing includes all Stage A services plus the loading of weapons and/or film/video tapes and the replenishment of chaff and flares. This

includes the processing and interpretation of any exposed film/video from the previous mission (32:A-1).

Commonality: a state achieved when groups of individuals, organizations or nations use common doctrine, procedures and equipment (35:87).

Compatibility: capability of two or more items or components of equipment or material to exist or function in the same system or environment without mutual interference (35:87).

Consumer Logistics: that part of logistics concerning reception of the initial product, storage, transport, maintenance (including repair and serviceability), operation and disposal of material. In consequence consumer logistics includes stock control, provision of construction of facilities (excluding any material element and those facilities needed to support production logistic facilities), movement control, reliability and defect reporting, safety standards for storage, transport and handling and related training (35:19).

Interchangeability: a condition which exists when two or more items possess such functional and physical characteristics as to be equivalent in performance or durability and are capable of being exchanged one for the other without alteration of the items themselves or of adjoining items, except for adjustment, and without selection for fit and performance (35:87).

Interoperability: the ability of systems, units or forces to provide services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together (35:87).

Joint Venture: product development and manufacture of commercial aircraft and engines involving more than one firm and significant levels of interim cooperation in research, design, production, and marketing, as well as significant contribution of development funds or risk capital (31:3).

Production Logistics: that part of logistics concerning research, design, development, manufacture and acceptance of material. In consequence, production logistics includes standardization and interoperability, contracting, quality assurance, procurement of spares, reliability and defect analysis, safety standards for equipment, specifications and production processes, trials and testing (including provision of necessary facilities), codification, equipment documentation,configuration control and modifications (35:19).

Rationalization: any action that increases the effectiveness of defense resources committed to the alliance. Rationa'ization includes consolidation and reassignment of national priorities to higher alliance needs, standardization, specialization, mutual support or grater co-operation. Rationalization applies to both weapons/material resources and organizational and procedural matters (35:86).

Standardization: within NATO, the process of developing concepts, doctrines, procedures and designs to achieve and maintain the most effective levels of compatibility, inter-operability, interchangeability and commonality in the fields of operation, administration and material (35:86).

II. Literature Review

Chapter Overview

The purpose of this chapter is to reach some conclusions from the search in written literature, about the necessity of standardization to achieve interoperability as a mean to accomplish the objective of cross-servicing among the different countries, and different aircraft, within the North Atlantic Treaty Organization.

Justification. "Since its beginning, NATO leadership recognized the need for common standards to achieve interoperability" (6:15). But, "Talking about standardization in NATO is like reading a newspaper. People don't want to read the good news, they're far more interested in the bad news" (35:86). The logistic situation in Europe, especially after the activation of current Rapid Reinforcement Plans (RRP) in time of crisis or war, does not guarantee the required support.

> If past exercises are any indication some of those U.S. units may have arrived in Belgium only to find that local forklift operators may have discovered that they could not reach the cargo bays of U.S. airlifters (28:30).

Regardless of the scarce resources and declining defense budgets, one feasible way of improving the situation is by means of standardization to optimize the employment of existing equipment.

Scope. In order to keep the information current (except from books and regulations), the scope of this chapter will be limited to reviews published after 1985.

Method of Treatment. The method selected will be from a cause-solution perspective, beginning with a quick look at the strategic situation. Then the logistic situation will follow and last, there will be an examination of standardization as a means to achieve interoperability, thus improving cross-servicing capabilities.

Strategic Situation

As stated by Vice Admiral Jon L. Boyes, "NATO continues as a major restraint on the Soviet Union's world hegemony" (6:15). However, to maintain its capability of deterrence with an adequate level of credibility, the forces should be in balance on both sides of the Iron Curtain.

Unbalance in Conventional Forces. In spite of the disagreements about the depth of the gap in conventional forces between NATO and the Warsaw Pact (18:45; 4:32; 19:30), the figures in the Department of State Bulletin (18:45) can be trusted (Table 1).

As can be seen, there is still a large difference in artillery, mortars, and tanks. This shift of equilibrium is worse in the Central Region. However it can be argued that there is a technological difference between NATO and the Warsaw Pact that balances same forces, this difference is ever thinner while the total forces gap is ever broader. It

is interesting to note that talking about equilibrium in NATO does not necessarily mean rearming, but according with the Harmel Report, quoted by Leopold Froehlich (22:19): "we want both security and dialogue, a just and stable order, but in freedom."

Table 1. NATO-WP Conventional Forces Balance

		DIVISION	TANKS	ARTILLERY/MORTAR	FIGHTER/BOMBER
South Region	NATO	45	5250	6000	615
	WP	42	8455	6235	695
Central Region	NATO	38	8050	4400	
	WP	61	16620	10270	
North Region	NATO	5	115	520	
	WP	9	1800	2400	
North & Central	NATO				1345
	WP				1555
TOTALS	NATO	88	13415	10920	1960
	WP	112	26875	18905	2250

There are plans for the gap between conventional forces to be filled through the concurrent effects from a set of measures whose most important and known components are Flexible Response and Rapid Reinforcement Plans.

Flexible Response. The effectiveness of the nuclear umbrella could be called little better than doubtful, especially after the Intermediate Nuclear Forces Treaty, which puts some stress on the conventional forces. However, nuclear weapons will remain necessary.

Purely conventional deterrence has never worked in Europe. either new technologies nor the currently fashionable new strategies will enable Europe to be defended with conventional weapons alone. As stated by Leopold Froelich in (22:19), the reason for this is simple:

> The Soviet Union will still be a nuclear power on the European continent. There is no way of putting a chicken back into an egg.

Rapid Reinforcement Plans (RRP). These are plans to airlift 14 brigades from the U.S. to Europe to join the 16 brigades already there. Reinforcement Plans have been practiced every other year with REFORGER exercises, which allows a good readiness level, but present U.S. airlift capabilities can only manage the transport of 7 brigades. Nevertheless, civil airlines will help to improve these figures (18:52; 4:37).

Withdrawal of U.S. from Europe

Now the question is: can Europe take care of its own defense? According to Zbigniew Brzezinski, former National Security Advisor to President Carter, 373 million Europeans with an economy of $3.5 trillion should not depend so much on 241 million Americans with $4 trillion, against an opponent with 275 million people and $1.9 trillion (4:32). But these figures do not contemplate the most important factor: the difference in military strength between the two forces in the theater (18:45).

Logistic Situation

The logistic support for the U.S forces in Europe is to be provided in three principal ways according to current Memoranda of Understanding (MOUs); prepositioning of War Reserve Stocks available at 70 allied bases and 85 storage locations in 12 nations; resupply by surface ships across the Atlantic; and Host Nation Support (HNS), or civil and military assistance in peace and war by a host nation to allied forces (35:50).

Considering these carefully planned measures, they alone should not be enough to guarantee the logistic support, unless the combined forces achieve the level of interoperability that enables smaller forces, as found in NATO, to offset larger forces, as the Warsaw Pact. Interoperability is a means to allow these diverse forces to fight together despite their differences or deficiencies, as stated by Admiral Jon L. Boyes in (6:15). And the top priority areas for interoperability in NATO are command, control, and communication systems; cross-servicing of aircraft; ammunition; and compatible battlefield surveillance/target designation/acquisition systems (16:11-3).

Solution: Standardization to Achieve Interoperability.

In short, interoperability is the relative term which designates the ability to provide and receive services; standardization is militarily the tool that makes it possible to reach the most effective levels of interoperability.

Economically, standardization means non-duplicative development. Politically, standardization means the closest possible cohesion among Alliance members (9:134). In practice standardization/interoperability is a continuum. What appears as interoperability at one level may result from standardization at another level. Adequate interoperability of equipments can be achieved precisely because some vital component, procedure, or specification has been standardized (21:12-267). There are also various levels of interoperability of which the lowest is compatibility or the lack of interference; then an emergency substitute, which requires previous approval by national technicians before one item can be used; and last, interchangeability or the highest attainable level of interoperability. There is still commonality, but this is an ideal term too difficult to be reached for different weapon systems (35:86,87).

Development of Standards

It is worth writing for the fourth time, without changing a comma, the phrase from Shri Rajagopalachari, being quoted in L. C. Verman's book Standardization "Standards are to industry as culture is to society" (22:88).

In spite of the usefulness of standards the way for standardization to be transformed into practical benefits has not always been easy, because people rebel against unifying measures (22:88). But, in the end, standardization is required to create complex structures.

Standards are developed in three phases: specification (when the constants are designed), simplification (reduction of varieties), and unification, which is the most difficult to be achieved, as it tries to impose order on an unruly universe of things and opposed interests (22:88). Standards are born as decided by governments, industry committees, or the market; and, in spite of the activities of the International Organization for Standardization, standards can be used for impeding fair competition in the marketplace. Antitrust officials must keep an eye on the companies, especially in the U.S. (42:65). Another danger coming from the poor use of standards is extreme proliferation, because too many are the same as none. So Robert Jules Siegel compared standards with the international language Esperanto; which never caught on (26:104). However, far from falling into this rather negative vision, it is possible to see the other face of the coin, with the development of the Open Systems Interconnection as an example of how it is possible to balance standards and fair competition (25:49-52).

How Standardization Affects Interoperability. As Maj. Gen. Norman Archival stated:

> Interoperability is accomplished through technical standards (equipment to equipment, system to system); procedural standards (human to human, human to computer, and computer to computer); and interoperable procedures (field procedures) (2-1C9).

The Problems of Standardization. NATO is an alliance composed of 16 nations with different cultures, political

attitudes, economic and technical capabilities. Logistics remains a national responsibility. Thus, progress has been less than ideal for interoperability measures between member nations (6:15). As Frederick Bonnart describes, there are some differences between the allies with regard to the distribution of the common defense which has to be supported by all of the members (burden sharing)(5:13). These differences increase when the figures are related to the international defense trade where the relative proportions between exports and imports have changed, with a tendency toward balancing the differences (19:19,20). While this situation should be satisfactory for the European NATO countries, it has brought about a current of protectionism on the American shore. Deputy Secretary of Defense William H. Taft stated "The U.S. must demand reciprocity for our efforts to open our defense markets to our allies" (30:45). However, the trade of defense products is not an exclusive problem between the two sides of the Atlantic, but among European countries as well, i.e. the British Aerospace's attempt to interfere in the Tornado trade between Malaysia and Panavia, for instance (38:5). It could be concluded that the alliance is not the best environment to ask for measures leading toward standardization and interoperability. Hopefully, Mr. Taft's words before the Senate Armed Forces sub-committee will not receive just lip service from the alliance's governments: "The individual concerns of our nations must be weighed against our first

priority: allied security" (38:5). The alliance credibility to deter the threat in Europe is at stake.

The failure to achieve RSI in NATO is surprising considering that civilian aviation uses equipments built in competition by a variety of manufacturers. These devices must be interoperable and must interface successfully with ground equipments in many countries. All of these results are obtained without complete standardization. The combination of RSI and FFF (form, fit and function) solves the problem without preventing intense competition among the suppliers (21:12-134).

Hidden behind the curtains are the economics of cooperative programs versus buy off-the-shelf, and today cooperative program are the only choice to achieve the economies of scale that large production runs enable, although with the drawbacks of longer time spent in the program, larger quantity of fixed resources, longer delivery schedule, and lower mobility of workforce (23:34-39). And the first cooperative program, codevelopment, typically leads to increase cost growth, schedule slippage, and performance compromises for the parties involved (29:vi).

Aircraft Cross-Servicing within the NATO Alliance

Introduction. Continuing with the line of thought that flows from the preceding paragraphs, it is important now to state that on behalf of the cross-servicing of aircraft systems in NATO, as a logical consequence of its vital impor-

tance for allied operations, there has been produced the most complete and well developed set of measures which make it possible to safely service aircraft out of their home base. However, there is a limit to what can be done with regulations and training, which human effort cannot overcome. As an example, it is absolutely impractical to keep updated technical publications, armament loading equipment, test equipment, and so on, for the 23 different types of fighter aircraft in NATO, at each and every suitable airbase within the potential area of operations. Moreover, reconnaissance aircraft, electronic combat aircraft, intra-theater airlift aircraft, command and control aircraft, and strategic bombers, make the situation even worse (41:40). This is a situation which lies far behind the day-to-day easy operations of commercial airlines around the world. The solution for them, as said before, came without complete standardization through RSI and FFF (21:12-134).

Regulations. NATO Standardization Agreement (STANAG) 3430 is the prime document covering cross-servicing of aircraft within NATO, but excluding cross-servicing of helicopters engaged in land operations (STANAG 3907). A general information about STANAG 3430 has been included in Table 2 below (32:1-iv).

Regardless of how comprehensive and functionally well developed the system is, because of the inherent lack of interoperability, cross-servicing capabilities are identified only for designated aircraft to selected airfields/ships.

TABLE 2. STANDARDIZATION AGREEMENT 3430

AIM: Define Responsibilities for NATIONS
NATO COMMANDERS
ACE/SACLANT INFO CENTERS

RESPONSIBILITIES:

NATIONS:
- Maintain agreed cross-servicing Capabilities (NBC)
- Provide Facilities
- Provide Info to ACE/SACLANT Info Centers
- Develop and distribute Procedures for Loading A/C
- Provide Ground Crew Training Video Tapes
- Report Airfield/Ship cross-servicing Capabilities
- Provide Consumable Products for cross-servicing

NATO COMMANDERS:
- Formulating and promulgating CS Policies
- Identify Airfields/Ships - Aircraft CS Requirements
- Train and Exercise
- Report CS. Requirements

ACE/SACLANT INFORMATION CENTERS:
- Formulate and promulgate CS Plans and Procedures
- Determining Documentation needed
- Establish Documentation Distribution System
- Distribute Documentation
- Advise appropriate agencies on Standardization
- Co-ordinating CS Operational Training and Exercise
- Monitoring development of CS capabilities

ANNEX A: TERMS AND DEFINITIONS (included in section 1)

ANNEX B: MINIMUM SERVICES REQUIRED

STAGE A:
- Documentation
- Fuel, Oil and Lubricants
- Adaptors
- Gaseous and Liquid systems
- Engine Start Facilities
- Shelters
- Towing Facilities
- Trained Ground Crews
- Power for Navi Stab

STAGE B: All Stage A, plus:
- Arming Tools, Instructions and Equipment
- Jettisonable Fuel Tanks
- Ground handling Equipment
- Weapon loading Teams
- Film Process & Interpret, Facilities & Personnel
- Weapon load Schedules
- Operating Stores

ANNEX C: CROSS-SERVICING GUIDES
- Leading Particulars
- A/C Handling, Launching, Recovery, etc.
- Replenish, Servicing, Testing, Starting, Cooling
- Main Systems
- Locally Manufactured Items
- Inspections
- Armaments
- Glossary and Index

TABLE 2. STANDARDIZATION AGREEMENT 3430 (CONTINUED)

ANNEX D: RESPONSIBILITY QUALITY CONTROL OF CONSUMABLES:

OWNER NATION:

- Ensure stocks are fit for use
- Ensure containers properly marked
- Monitor, retest, and rotate prepositioned stocks
- Advise Host Nations of revised life expiry
- Ensure quality control info to Host Nations

HOST NATIONS:

- Monitor remaining life of stocks
- Advise owner when approaching life expiry
- Seek additional quality control info

ANNEX E: STANAG's ESSENTIAL FOR CROSS-SERVICING OF A/C STAGE A (See STANAG 3430 page E-1)

ANNEX F: STANAG's ESSENTIAL FOR CROSS-SERVICING OF A/C STAGE B (To be Issued)

RATIFICATION AND IMPLEMENTATION DETAILS

RESERVATIONS:

- CA :Size of paper
- FR :Limited to Stage A . Not Chemical Environ. Guides only for their A/C
- IT :All but Recce limited to Stage A
- RNLN :Limited to Stage A . No drag chutes service Not apply STANAGs 3372, 3447, 3595, 3806
- RNLAF:Video tapes only for Recce Ground crew video tapes not mandatory
- NO :Shelters provided on Avail/Priority basis No stocks or weapons provided or earmarked
- PO :limited to Stage A . Only for their A/C Guides only in Portuguese and English
- TU :No NBC capabilities . No adaptors provided
- UK :Do not accept format for CS Guides

COMMENTS:

- UK :Royal Navy do not implement until advised of NATO commanders requirements British Army not implement for fixed wing and STANAG 3907 for helicopters
- US :US ARMY STANAG 3907 in lieu of 3430

This first limitation ties cross-servicing capabilities to certain strategic concepts, therefore restricting flexibility as a primary characteristic of all air forces. Moreover, the

system is dependent upon the development of the proper skills among the ground crews, specially when servicing is to be performed in a hurried crisis/conflict environment, and everybody knows that there is a physical limit for the number of different types of aircraft on which the adequate proficiency level can be ma. 'ained. Nonetheless, the system assumes the availabilit ground handling equipment, armament loading equipment, .est equipment, technical publications, adaptors, prepositioned consumables, training devices, etc., whose number increases with every new type of aircraft serviced, restricting even further aircraft's operational flexibility.

As can be appreciated in Table 2, the reserv..tions to STANAG 3430 implementation are many and diverse, affecting matters as important as French or Portuguese implementation only to their own types of aircraft or similar. Moreover, four countries limit the implementation to Stage A, which largely reduces the usefulness of cross-servicing system in wartime.

STANAG 3907 addresses the same cross-servicing topic but directed only toward the helicopters involved in land operations (33:1-B-iv). There is a trend within NATO's EUROLOG to cover STANAGs 3430 and 3907 under a single STANAG.

Air Force Regulation 400-5 dated 1 October 1971, because of its early issuance addresses a less developed concept of cross-servicing, devoted more to the support in case of

emergency landing or in NATO exercises, closer to today's emergency supply support for consumables, but without the special aim to wartime operations underlying the spirit of STANAG 3430. However, some important concerns about the common use of public funded assets can be found in AFR 400-5 (13:2).

> Cross-servicing will not be considered a medium for over-the-counter sales established primarily to purchase spare parts to maintain aircraft in current inventories of other NATO nations.

Military Specification MIL-M-9977 meets the need for manuals, technical and checklists for munitions loading. A paragraph addresses the checklists for Stage B of cross-servicing (14:5).

Military Specification MIL-M-22202C develops for US DOD the requirements for mandatory cross-servicing guides as directed in STANAG 3430 (17:1-37).

Conclusion

In the preceding pages, the strategic situation in Europe was discussed, stressing the gap in conventional forces between NATO and the Warsaw Pact. The discussion covered the way this gap could be filled by means of U.S. reinforcement, and the logistic situation created, which added to decreasing defense budgets, this appears to call for a better employment of the available assets through standardization to achieve interoperability.

From the spectrum of different options collected, it can be concluded that standardization and interoperability are of vital importance both within the alliance, and among the different services of each member's armed forces. The present situation is neither hopeless nor ideal, but requires a detailed study to determine whether the speed of change in the environment, which requires standardization, is faster or slower than the speed of adapting inside the Alliance. The situation lies far beyond Warsaw Pact, and West World commercial airlines interoperability levels. This situation means that for cross-servicing of aircraft purposes, the present diversity of equipment is both dangerous because of the differences with the potential threat, and apt to be solved because of the similarities with commercial airlines.

III. Methodology

Chapter Overview

This chapter includes a first general discussion about the logic underlying the connection between the research question and the investigative questions, and from there on to the methodology employed to answer the questions.

Research Design

The problem proposed for research consists of an appraisal of the most likely way to solve the actual logistic situation concerning the cross-servicing of aircraft within NATO under an evolving political,economic, and military situation. The choices between the different options are to be made, at many different levels, by the logistics decision-making organizations within the Alliance and aerospace industry. Considering that there is no known published research study about the topic of cross-servicing to be utilized as a basis for quantitative longitudinal comparison, and assuming that the NATO logisticians answers to a questionnaire will be the best estimator for the actual policies in the different decision-making organizations, the method selected to answer the research question is a survey among those involved in the logistics decision-making. This exploratory survey will provide the quantitative data to identify the perceived major factors impacting upon the stated problem, the cross-servicing problem perceived situation, its causes, effects, respon-

sible organizations, and its most likely solutions. Figure 9 shows the research design process.

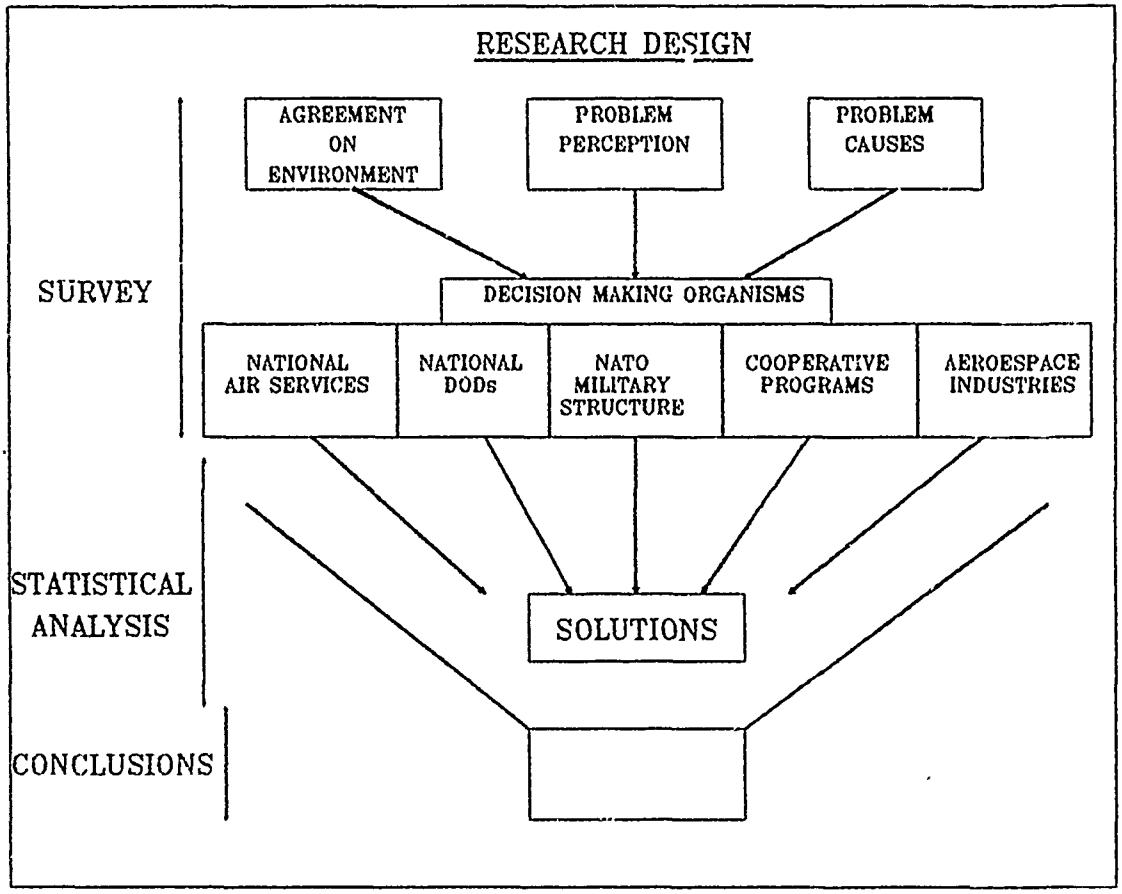

Figure 9. Research Design

Pre-experimental Design

The conscripting characteristics of the unstructured problem, the mixed attributes of the decision-making population, and the impossibility to control the variables, largely determine the choice for the pre-experimental design.

One Shot Case Analysis

Although the one shot case analysis is the weakest among the preexperimental designs, it is used because it was impossible to identify a true control group which has not been affected by the new environment circumstances, while still belonging to the population of NATO logisticians.

So many restrictions will obviously limit the ability to determine cause and effect relationships among the variables to a mere determination of the general trends. The one shot case analysis threats to internal validity of the results will be attenuated by asking the opinions to a large number of diverse populations so that the presumable bias which might appear if a single group would be addressed will be prevented.

Figure 10 depicts the experiment design for this one-shot-case study, regarding the new environmental factors as a treatment on the population of NATO logisticians about the effects on the cross-servicing of aircraft(20:120).

INVESTIGATIVE GROUP	X	O
NATO Logisticians	Treatment: New Environment	Survey

Figure 10. One - Shot Case Study (20:120)

The Population

The generic population defined as NATO logisticians will be tentatively considered as composed of several sub-populations, and sub-sub-populations (Figure 11).

POPULATION	SUB-POPULATION	SUB-SUB-POPULATION
NATO LOGISTICIANS	MILITARY	NATIONAL AIR SERVICES NATIONAL DODs NATO MILITARY STRUCTURE COOPERATIVE PROGRAMS
	CIVILIAN	NATIONAL DODs NATO CIVILIAN STRUCTURE COOPERATIVE PROGRAMS AERONAUTICAL INDUSTRY

Figure 11. Population Break-Down (Organizations)

These populations will be further grouped according to geographic areas (Figure 12).

GROUPING	COMPARISON	COUNTRIES
I GLOBAL	EUROPE	BELGIUM,DENMARK,FRANCE GERMANY,GREECE,ICELAND ITALY,LUXEMBOURG,NORWAY NETHERLANDS,PORTUGAL, SPAIN,TURKEY,U.KINGDOM
	AMERICA	UNITED STATES,CANADA
II REGIONAL	SOUTHERN	GREECE,ITALY,PORTUGAL SPAIN,TURKEY
	CENTRAL	BELGIUM,FRANCE,GERMANY LUXEMBOURG,NETHERLANDS UNITED KINGDOM
	NORTHERN	DENMARK,NORWAY,ICELAND
	AMERICA	UNITED STATES,CANADA

Figure 12. Population Break-Down (Continents-Regions)

Variables Definition. The special characteristics of this unstructured topic prevent the possibilities to develop a mathematical model which should be based upon longitudinal data about additive variables. The tentative anticipated

results of this research are then to determine the variables involved in the problem, and the possibility to identify the similarities and differences among the populations. The problem stated relates first to the perception of the assumed environmental factors, then to their effects on RSI (and thus on cross-servicing), the causes and responsibility for the present situation, and finally to the most likely solutions.

The criterium of consistency within sections was adopted to select between the minimum possible number of choices for each answer but still choices diversified enough to adequately define the variable. The number of different choices presented within each question depends then on the degree of definition required while keeping consistency within each section.

Environmental Factors. To determine the relative order of importance of the factors impacting the new environment, political, economical, and military factors are ranked between 1 and 5. Then the top five factors are ranked among themselves.

Effects. What are the perceived effects of the preceding environment factors upon NATO logistics situation? The effects are ranked between 1 and 5, from strongly negative to strongly positive.

Next, three variables define the degree of perception of the actual situation as a problem:

Situation. This is a general valuation of the current situation concerning cross-servicing, ranked from Excellent (1) to Hopeless (7).

Priority. This is the perceived quantitative importance of cross-servicing in relation to the rest of the dominant topics of management, ranked from Excellent (1) to Hopeless (7).

Frequency. It is the approximate number of times per year that respondent's country recurred to cross-servicing, ranked from 1 (less than 10 times/year) to 7 (more than 70 times/year).

The causes of the problem are addressed by two variables:

Causes. The attributed relative importance of the different factors leading to the present diversity of material. Political, economic, and military causes are ranked together between 1 and 9.

Responsibility. The relative possibilities for implementing the measures to solve the problem at the different levels involved in the decision-making process. Organizations are ranked between 1 and 10.

Two variables inquire about the areas upon which the cross-servicing deficiencies have a more decisive impact:

Areas impact. The relative order of the areas where the problem impacts the cross-servicing of aircraft. Peacetime and wartime areas are ranked together between 1 and 10.

Areas benefit. The areas that would produce the most benefit from the correction of cross-servicing deficiencies. Areas are ranked between 1 and 10.

Four variables mark the respondents estimated solutions to the cross-servicing problem:

Sub-System. It is the relative ranking of importance of the cross-servicing sub-systems. They are ranked between 1 and 10.

Role. It is the relative ranking of responsibility for the different logistics organizations involved in the solution of the cross-servicing problem. They are ranked between 1 and 10.

Cooperative programs. It is the relative ranking of feasibility for the different cooperative programs. They are ranked between 1 and 7.

Aeronautical Industry. It is the relative ranking of the aerospace industry levels according with their suitability to diversify or redirect their production to cope with the contraction of defense markets. They are ranked between 1 and 4.

In Table 3 all the preceding variables are detailed, the types of scale in which they have been ranked, the extreme values or conceptual divisions for each variable, and the statistical test applied in each case to verify the homogeneity among the different subpopulations object of survey research.

Table 3. Variables Definition

VARIABLE	TYPE OF SCALE	VALUES	STATISTICS TEST
ENVIRONMENT PERCEPTION			
FACTORS	ORDINAL	POLITICAL ECONOMIC MILITARY	CHI-SQUARE
EFFECTS	INTERVAL	1 TO 5	KRUSKAL/RANKSUM
CROSS-SERVICING SITUATION			
SITUATION	INTERVAL	1 TO 7	KRUSKAL/RANKSUM
PRIORITY	INTERVAL	1 TO 7	KRUSKAL/RANKSUM
FREQUENCY	INTERVAL	1 TO 7	KRUSKAL/RANKSUM
PROBLEM CAUSES			
CAUSES	ORDINAL	POLITICAL ECONOMICAL MILITARY	CHI-SQUARE
RESPONSIBILITY	ORDINAL	AFs, DODs, NATO,MANUF, ENGINE, AUX.	CHI-SQUARE
PROBLEM IMPACT			
AREAS IMPACT	ORDINAL	PEACETIME WARTIME	CHI-SQUARE
AREAS BENEFIT	ORDINAL	ARMAMENT TO SHELTERS	CHI-SQUARE
PROBLEM SOLUTIONS			
SUB-SYSTEM	ORDINAL	ARMAMENT TO SHELTERS	CHI-SQUARE
ROLE	ORDINAL	AFs, DODs, NATO,MANUF, ENGINE, AUX.	CHI-SQUARE
COOP PROGRAM	ORDINAL	CODEVELOPMENT, LICENSED PROD, COPRODUCTION, PACKAGES, FAMILY WEAPONS OPENING DE- FENSE MARKETS	CHI-SQUARE
INDUSTRY	ORDINAL	AIRFRAME, MAJOR SYSTEMS, AUXILIARY.	CHI-SQUARE

Survey Plan. To verify the survey internal validity, a first questionnaire test was administered to the international officers assigned to the Air Force Logistics Command, International Logistics Center, Wright-Patterson Air Force

Base. Once the survey questionnaire was refined, it was sent to all the organizations defined in the population break-down figure. To the military organizations, and civilians within cooperative programs, the questionnaires were sent on a functional basis (one per national office). To the aerospace industries, the questionnaires were sent stratified by country market share (3:3) and then randomly selected from each industry level within the aeronautical industry directory (Table 5).

Table 4. Survey Plan

	ORGANIZATION				ADDRESSEES
ARMED FORCES	EUROLOG				25
	NATO HEADQUARTERS				14
	EUROPEAN COOPERATIVE PROGRAM (AERONAUTICAL INDUSTRY)				6 8
	INTERNATIONAL LOGISTICS CENTER				14
		TOTAL			67
AERONAUTICAL INDUSTRY	MARKET SHARE $ Bill 1981	ADDRESSEES INDUSTRY LEVEL 1	2	3	TOTAL
USA	60	20	20	20	60
UK	10	3	3	4	10
FR	10	3	3	4	10
FRG	6	2	2	2	6
CAN	3	1	1	1	3
ITA	2	1	1	–	2
SP	1.5	1	–	1	2
NE	1	1	–	–	1
BE	1	–	1	–	1
PO	.5	–	1	–	1
GR	.5	–	1	–	1
DE	.5	–	1	–	1
TK	.5	–	1	–	1
NO	.5	–	1	–	1
TOTALS	97	32	36	32	100
		GRAND TOTAL			167

Statistical Analysis

The statistical analysis of the survey data consists of a series of homogeneity tests among the different sub-populations, and sub-sub-populations, for each variable considered. The objective is to find out whether there is a lack of homogeneity among the opinions of the defined populations within the decision-making organizations. This lack of homogeneity or agreement would help explain the diversity of types of aircraft, and the lack of interoperability, thus cross-servicing of aircraft within NATO (Table 6).

For ordinal variables, where the data are grouped by order of precedence, there is no sense to talk about the mean value, because there is no meaning for the interval between two categories. Moreover, although the median is recommended as the best indicator of central tendency for ordinal variables (20:251), the mode or rank preferred by more respondents was computed too, for it reflects the real way in which agreements are reached. The rank percents give the measure of dispersion. However, the percents might not add to one hundred as they have been rounded up to the closest integer value. If the CHI-SQUARE test of homogeneity was passed, the mode was taken as the 'most voted' opinion on the topic throughout the alliance. Otherwise, the Coefficient of Concordance has been computed for the rejected subpopulation to detect the causes of divergence. For the interval variables, the Wilcoxon Ran-Sum or Kruskal-Wallis tests, and the

Spearman Correlation Coefficient detect differences among populations (20:360). The average as a measure of central tendency and the standard deviation as a measure of dispersion were computed on these interval variables.

Table 5. Statistical Analysis

MEASURE	VARIABLE	COMPARISON PAIRED		TECHNIQUE
ORDINAL	FACTORS	TWO-SAMPLES K-SAMPLES	N N	CHI SQUARE TWO SAMPLE CHI SQUARE K SAMPLES
INTERVAL	IMPACT	TWO-SAMPLES K-SAMPLES	N N	WILCOXON RANK SUM KRUSKAL-WALLIS ONE-WAY ANOVA

These conclusions will help to structure somewhat the problem and become the basis for further research.

Specific Research Steps

Survey Package. The following steps have been followed to evaluate the stated problem:

1. Determine the relevant factors of the environment affecting the cross-servicing of aircraft within NATO, by means of the literature review, the pilot survey administered to the officers assigned to the International Logistics Center (AFLC/ILC), and the respondents' answers to the survey package.

2. Identify the consequences of those factors upon situation of cross-servicing within NATO, the tentative causes of the problem, and the possible solutions, from the answers to a survey among the above defined populations.

3. Statistically evaluate the responses to determine possible differences among the different sub-populations. Find out the measures of central value and dispersion for the distributions of answers.

4. Conclude, about the research questions, the preferred stated opinion among the survey respondents.

Software Packages Used

Survey results spreadsheet: QUATTRO.

Statistical analysis: STATISTIX, and INTERACTIVE STATISTICAL PROGRAMS.

Graphics: QUATTRO, and HARVARD GRAPHICS.

IV. Survey Results

Chapter Overview

This chapter begins with a paragraph on the general considerations about the survey, response rates and qualifications; next the survey results are presented section by section; and finally, a conclusion summarizes the chapter content.

General Considerations

Questionnaire Design. As there was no known antecedent for this research, the questionnaire was to be designed from the concepts in the literature review, the author's experience on the topic, and the models in Emory (20:Chapter 7). The survey questionnaire is included as appendix A. To gather the respondents' personal opinions all the paragraphs were finished with an open ended question. Some problems were identified a posteriori on the wording of some questions. Question number 2 (Top Five Factors), section 2 (Environment Perception), was not understood by 64 % of the respondents, whereas in the oral presentation to the test group, the question did not present any problem at all, which confirms the wording problem in the questionnaire.

Two key questions were related in different pages to cross-check the validity of the answers. The question about the organizations responsible for the present situation and organizations' role in the problem solution; and the question

concerning the areas of cross-servicing which would benefit most from the correction of the problem, and the areas which represent the best opportunity to help solve the problem.

Response. A more detailed description of the survey results and graphics is included as appendix B. Ten respondents excused their participation because of their lack of knowledge about cross-servicing, unproper addressing of the topic outside the official chain, or questionnaires returned blank without any reason.

Significant differences have been appreciated among the response rates, specially between the civilian and military populations (Table 6).

Table 6. Response Rates

REGION	QUESTIONNAIRES RECEIVED		QUESTIONNAIRES SENT		RESPONSE RATES	
	CIVIL	MILITARY	CIVIL	MILITARY	CIVIL	MILITARY
NORTHERN	1	2	2	5	0.5	0.4
CENTRAL	6	15	31	29	0.2	0.5
SOUTHERN	6	9	13	17	0.5	0.5
AMERICA	8	5	62	8	0.1	0.6
TOTALS	21	31	108	59	0.2	0.5

ORGANIZATION	QUESTIONNAIRES RECEIVED	SENT	RESPONSE RATE
NATIONAL AIR FORCES	3	6	0.50
DEPARTMENTS OF DEFENSE	2	10	0.20
COOPERATIVE PROGRAMS	18	22	0.86
NATO BODIES	9	23	0.39
AIRCRAFT MANUFACTURERS	8	45	0.18
ENGINE MANUFACTURERS	6	12	0.50
AIRCRAFT PARTS & AUXILIARY EQUIPMENT	6	49	0.12
TOTALS	52	167	0.31

However, to confirm the significance of these differences, further research should connect broader topics with different survey sponsorship.

Survey Results

All the homogeneity tests within this section have been evaluated at a level of significance of 0.05, which means that for any p-value higher than 0.05 there is not enough evidence to reject the null hypothesis of homogeneity among the different subpopulations considered.

Section 1. Demographics. This section allowed the stratification of respondents to assign them to the several subpopulations defined for the statistical analysis.

Section 2. Environment Perception. The purpose of this section was to define the relative importance of the NATO environmental factors impacting upon NATO logistics situation. This section was further divided into three factors: political, economic, and military.

Political. The political factor was subdivided into five sub-factors (the fifth being the open ended 'other').

Perestroika and Glasnost. The results for this subfactor are concentrated around the two first ranks,with more than half the respondents considering it on the first place. Both the mode, or rank selected by the majority of respondents and the median are rank one (Table 8). There is not enough evidence to reject the null hypothesis of homogeneity for any of the subpopulations.

Table 7. Perestroika and Glasnost

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	29	16	5	2	0						1	1
PERCENTS	56	31	10	4	0							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.63	0.73	YES	CIVILIAN/MILITARY
	1.22	0.75	YES	EUROPE/AMERICA
	0.01	0.92	YES	ORGANIZATION
	0.01	0.92	YES	REGION

Terrorism. The results for this subfactor are spread across the ranks presenting a flat distribution. The mode, or rank selected by the majority of respondents, is rank four, and so is the median. The homogeneity test among the opinions of the different populations is only rejected for the organization's subpopulation. The high coefficients of concordance of 0.90 between the answers of aircraft manufacturers/assemblers and NATO civilian/military Organizations, and above 0.70 for two more pairs of subpopulations among others, are responsible for the rejection of the homogeneity test (Table 8).

Table 8. Terrorism

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	2	9	12	14	11						4	4
PERCENTS	4	19	25	29	23							

Table 8. Terrorism (Continued)

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	5.82	0.21	YES	CIVILIAN/MILITARY
	4.01	0.13	YES	EUROPE/AMERICA
	8.38	0.00	NO	ORGANIZATION
	1.26	0.26	YES	REGION

	COEFFICIENT OF CONCORDANCE						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	0.51	1.00					
COOP	0.35	0.72	1.00				
NATO	0.65	0.41	0.49	1.00			
MANUF	0.65	0.41	0.49	0.90	1.00		
ENG	0.75	0.39	0.25	0.57	0.57	1.00	
AUX	0.27	0.10	0.31	0.49	0.49	0.45	1.00

Pacifism. This subfactor shares characteristics with terrorism, but with a lower median which means a higher importance, and larger weight on the most selected rank which means more concentrated data. The null hypothesis of homogeneity is not rejected for any of the populations (Table 9).

Table 9. Pacifism

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	6	12	11	17	2						3	4
PERCENTS	13	25	23	35	4							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	2.40	0.49	YES	CIVILIAN/MILITARY
	3.92	0.42	YES	EUROPE/AMERICA
	1.10	0.30	YES	ORGANIZATION
	0.54	0.46	YES	REGION

INF Treaty. This subfactor shows similar characteristics to the preceding two, but with smaller mode. The null hypothesis of homogeneity among subpopulations is only rejected for the regions, where the coefficient of concordance between the subpopulations North and South is as high as 0.74 (Table 10).

Table 10. INF Treaty

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	9	11	15	11	1						3	3
PERCENTS	19	23	32	23	2							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	1.80	0.62	YES	CIVILIAN/MILITARY
	0.95	0.81	YES	EUROPE/AMERICA
	0.33	0.57	YES	ORGANIZATION
	5.52	0.02	NO	REGION

COEFFICIENT OF CONCORDANCE				
	NORTH	CENTRAL	SOUTH	AMERICA
NORTH	1.00			
CENTRAL	0.56	1.00		
SOUTH	0.74	0.47	1.00	
AMERICA	0.35	0.66	0.66	1.00

Economic. The economic factor was subdivided into five sub-factors.

Increased Weapon System Development Costs. The results for this subfactor are concentrated around the two first ranks with a slightly lower weight for the first rank

than Perestroika and Glasnost has. Here again the mode, or rank selected by the majority of respondents, as well as the median is rank one. There is not enough evidence to reject the null hypothesis of homogeneity for any of the comparisons, although the Europe-America subpopulations barely pass the test at the 0.05 level of significance (Table 11).

Table 11. Increased Weapon System Development Costs

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	27	18	3	3	1						1	1
PERCENTS	52	35	6	6	2							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	3.36	0.19	YES	CIVILIAN/MILITARY
	5.37	0.06	YES	EUROPE/AMERICA
	1.32	0.25	YES	ORGANIZATION
	2.53	0.11	YES	REGION

Competition on Armaments International Markets.

The results for this subfactor are concentrated around the second and third ranks with the mode and the median on rank two. There is not enough evidence to reject the null hypothesis of homogeneity for any of the comparisons (Table 12).

Table 12. Competition on Armaments International Markets

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	9	19	17	3	3						2	2
PERCENTS	18	37	33	6	6							

Table 12. Competition on Arms International Markets (Cont.)

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	1.17	0.76	YES	CIVILIAN/MILITARY
	4.20	0.38	YES	EUROPE/AMERICA
	1.24	0.27	YES	ORGANIZATION
	1.80	0.18	YES	REGION

Labor Force Pressure. The results for this subfactor are concentrated around the third and fourth ranks, with the highest level of agreement on the same rank (29 counts) among the environment factors besides Perestroika and Glasnost; the difference is that here the rank is rank four. There is not enough evidence to reject the null hypothesis of homogeneity for any of the comparisons (Table 13).

Table 13. Labor Force Pressure

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	4	12	29	5						4	4
PERCENTS	0	8	24	59	10							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.80	0.85	YES	CIVILIAN/MILITARY
	5.66	0.13	YES	EUROPE/AMERICA
	0.34	0.56	YES	ORGANIZATION
	0.34	0.56	YES	REGION

Industry Protectionism. The results for this subfactor are concentrated around the third rank, with a consistent median-mode value of three, and almost 40 % of the

responses on this rank. The homogeneity test among organizations is the only one rejected, where a coefficient of concordance is as high as 0.95, and five more are 0.80 or above. (Table 14).

Table 14. Industry Protectionism

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	6	12	20	11	2						3	3
PERCENTS	12	24	39	22	4							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.26	0.97	YES	CIVILIAN/MILITARY
	0.74	0.39	YES	EUROPE/AMERICA
	4.96	0.02	NO	ORGANIZATION
	0.95	0.81	YES	REGION

	COEFFICIENT OF CONCORDANCE						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	0.45	1.00					
COOP	0.79	0.61	1.00				
NATO	0.79	0.61	0.84	1.00			
MANUF	0.80	0.45	0.79	0.79	1.00		
ENG	0.80	0.45	0.79	0.79	0.80	1.00	
AUX	0.79	0.61	0.84	0.95	0.79	0.79	1.00

Military. The military factor was subdivided into five sub-factors.

Conventional Arms Gap NATO/Warsaw Pact. The results for this subfactor are concentrated around the two first ranks, whereas the mode is rank one, one rank apart from the median, which reflects a distribution with a heavy

right tail and the lowest counts on the first rank for the first factor among the environment factors. There is not enough evidence to reject the null hypothesis of homogeneity for any of the comparisons (Table 15).

Table 15. Conventional Arms Gap NATO / Warsaw Pact

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	20	15	9	5	2						2	1
PERCENTS	39	29	18	10	4							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.91	0.64	YES	CIVILIAN/MILITARY
	3.30	0.19	YES	EUROPE/AMERICA
	0.16	0.69	YES	ORGANIZATION
	4.30	0.23	YES	REGION

Insufficient Level of RSI. This subfactor shares the first place with the Conventional Arms Gap factor, but the insufficient level of RSI has an even heavier right tail, which accounts for the median-mode difference and the more dispersed percents. There is not enough evidence to reject the null hypothesis of homogeneity for any of the subpopulations (Table 16).

Table 16. Insufficient Level of RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	18	14	13	5	0						2	1
PERCENTS	36	28	26	10	0							

Table 16. Insufficient Level of RSI (Continued)

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	1.23	0.74	YES	CIVILIAN/MILITARY
	3.38	0.18	YES	EUROPE/AMERICA
	1.82	0.18	YES	ORGANIZATION
	2.32	0.51	YES	REGION

Logistics as a National Responsibility. The results for this subfactor are concentrated around the mode-median third rank, with heavy tails on both sides. There is not enough evidence to reject the null hypothesis of homogeneity for any of the comparisons (Table 17).

Table 17. Logistics as a National Responsibility

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	6	14	18	10	4						3	3
PERCENTS	12	27	35	19	8							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	2.51	0.64	YES	CIVILIAN/MILITARY
	8.59	0.07	YES	EUROPE/AMERICA
	3.28	0.07	YES	ORGANIZATION
	1.95	0.58	YES	REGION

Emergent Technologies. The results for this subfactor are concentrated around the fourth rank with the mode and the median both on rank four. However, the p-values are small, and the null hypothesis of homogeneity would be rejected for the civilian/military and organizations compari-

sons. According to the coefficient of concordance, there are several pairs of subpopulations above the 0.50 values, and specially three pairs are as high as 0.70 (the civilian/military 0.84). They are responsible for the lack of homogeneity: DOD's/NATO Bodies, and National Air Forces/Engine Manufacturers (Table 18).

Table 18. Emergent Technologies

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	3	9	10	25	3						4	4
PERCENTS	6	18	20	50	6							

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	7.65	0.05	NO	CIVILIAN/MILITARY
	1.75	0.62	YES	EUROPE/AMERICA
	4.46	0.03	NO	ORGANIZATION
	3.41	0.33	YES	REGION

COEFFICIENT OF CONCORDANCE		
	CIVILIAN	MILITARY
CIVILIAN	1.00	
MILITARY	0.84	1.00

	COEFFICIENT OF CONCORDANCE						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	0.44	1.00					
COOP	0.56	0.62	1.00				
NATO	0.56	0.57	0.65	1.00			
MANUF	0.30	0.42	0.71	0.69	1.00		
ENG	0.62	0.50	0.56	0.64	0.55	1.00	
AUX	0.10	0.16	0.35	0.42	0.76	0.29	1.00

Other Responses. A good level of participation has been registered in this open ended fifth question. It might be due to the special characteristics of the section about NATO environment in the first place within the questionnaire and touching a broad and open topic . However, the responses received were as diverse as the different populations they come from, for only one among the answers must be recognized as important enough (4 responses) to be considered at the same level as the proposed answers. The political, economic, and military consequences of what can be named 'European Community 92' is one factor in the future which is already felt as important and should be included in follow on research.

Top Five Factors. The responses to the top five environment factors within this question display the same order of preference as the above environment factors when considered one by one. The political Perestroika and Glasnost is again the leading factor, followed at some distance by the economic increased weapon systems development costs. The military factor conventional arms gap NATO/WP occupies the third place, and the military also insufficient level of RSI the fourth. The first factor beyond those included in Table 19 is INF Treaty with the same total counts as the competition in armaments international markets. Due to a problem in the questionnaire design, the statistical tests were not applicable because of the small number of valid responses.

Table 19. Top Five Environment Factors

	FACTOR	RANKS 1	2	3	4	5	MEDIAN	MODE
COUNTS	PERESTROIKA AND GLASNOST	14	3	1	1	0	1	1
PERCENTS		74	16	5	5	0		
COUNTS	INCREASED WEAPON SYSTEMS DEVELOPMENT COST	7	4	3	1	1	1	1
PERCENTS		44	25	19	6	6		
COUNTS	CONVENTIONAL ARMS GAP NATO/WP	1	5	3	1	0	2	2
PERCENTS		10	50	30	10	0		
COUNTS	INSUFFICIENT LEVEL OF RSI	1	4	3	4	1	2	BIMODE
PERCENTS		8	31	23	31	8		
COUNTS	COMPETITION IN ARMAMENTS INTNAL MARKETS	0	6	1	3	2	2	2
PERCENTS		0	50	8	25	17		

Effects of Environment Factors Upon NATO Logistics Situation. The purpose of this subsection was to determine the relative importance for the consequences of NATO environment factors upon the cross-servicing situation. This subsection was further divided into four effects: reduced defense budgets, increased conventional gap NATO-Warsaw Pact, increased force requirements, and the open ended question 'other.'

Reduced Defense Budgets. The results for this effect are heavily grouped around the first two ranks corresponding to strongly and moderately negative, with a small standard deviation of almost half the rank interval. The mode is rank 2, slightly above the mean rank of 1.6. The p-value

for the organizations comparison is small enough to reject the null hypothesis of homogeneity. Four correlation coefficients are as high as one, and two more are 0.82; high enough to enlarge the Kruskal-Wallis statistic and disturb the homogeneity among subpopulations (Table 20).

Table 20. Reduced Defense Budgets

	RANKS										MEAN	STANDARD	MODE
	1	2	3	4	5	6	7	8	9	10	RANK	DEVIATION	
COUNTS	20	28	0	1	0						1.6	0.6	2
PERCENTS	41	57	0	2	0								

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
RANK-SUM	0.42	0.67	YES	CIVILIAN/MILITARY
RANK-SUM	1.19	0.23	YES	EUROPE/AMERICA
KRUSKAL W	18.44	0.00	NO	ORGANIZATION
KRUSKAL W	4.13	0.25	YES	REGION

	SPEARMAN RANK CORRELATIONS, CORRECTED FOR TIES						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	-0.00	1.00					
COOP	-0.00	1.00	1.00				
NATO	0.34	0.40	0.40	1.00			
MANUF	0.34	0.40	0.40	1.00	1.00		
ENG	-0.00	1.00	1.00	0.40	0.40	1.00	
AUX	0.05	0.19	0.19	0.82	0.82	0.19	1.00

Increased Conventional Arms Gap NATO/WP. The results for this effect are concentrated around ranks two and four (moderately negative and moderately positive), with the highest value for two. The mean rank is then between them,

and the standard deviation is larger than the rank interval. The mode is rank 2 again, under the mean rank of 2.7. The p-value for the regions comparison is small enough to reject the null hypothesis of homogeneity, where the Central Regions vs. America correlation coefficient is 0.76 (Table 21).

Table 21. Increased Conventional Arms Gap NATO/WP

	RANKS										MEAN	STANDARD	MODE
	1	2	3	4	5	6	7	8	9	10	RANK	DEVIATION	
COUNTS	6	17	8	14	2						2.7	1.2	2
PERCENTS	16	35	16	29	4								

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
RANK-SUM	0.49	0.62	YES	CIVILIAN/MILITARY
RANK-SUM	1.75	0.08	YES	EUROPE/AMERICA
KRUSKAL W	3.64	0.72	YES	ORGANIZATION
KRUSKAL W	9.41	0.02	NO	REGION

SPEARMAN RANK CORRELATIONS, CORRECTED FOR TIES				
	NORTH	CENTRAL	SOUTH	AMERICA
NORTH	1.00			
CENTRAL	-0.00	1.00		
SOUTH	0.44	0.55	1.00	
AMERICA	-0.00	0.76	-0.00	1.00

Increased Force Requirements. The results for this effect are concentrated around the second rank, moderately negative, gathering 40 % of the counts, but with a heavy tail to the right. The mean rank is then displaced from the mode toward the higher ranks. The standard deviation is only moderate, and equal to the rank interval. The p-values are

large enough to fail to reject the null hypothesis of homogeneity for all the subpopulations (Table 22).

Table 22. Increased Force Requirements

	RANKS										MEAN	STANDARD	MODE
	1	2	3	4	5	6	7	8	9	10	RANK	DEVIATION	
COUNTS	3	19	12	12	2						2.8	1	2
PERCENTS	6	40	25	25	4								

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
RANK-SUM	1.45	0.15	YES	CIVILIAN/MILITARY
RANK-SUM	0.33	0.74	YES	EUROPE/AMERICA
KRUSKAL W	5.72	0.46	YES	ORGANIZATION
KRUSKAL W	2.35	0.50	YES	REGION

Other Responses. The number of answers to the open question was lower than that included in the environment section, and none of them received enough support to be considered as a significant input to the questionnaire.

Section 3. Cross-Servicing Situation. The purpose of this section was to determine whether the cross-servicing situation was truly felt as problematic; if so, the priority given to the solution within each country; and then, whether the situation translates into a genuine problem as a function of the frequency of cross-servicing system' utilization. This section was further subdivided into three subsections: cross-servicing situation, national priority given to the solution, and frequency of cross-servicing utilization.

Cross-Servicing Situation. The results for this question are concentrated around the ranks three (Fair) and five (Not Satisfactory) with a high value for the answer three. The mean rank is somewhat better than the neutral four, and the standard deviation is larger than the rank interval. The mode or rank selected by the majority of respondents is rank 3 (fair) under the mean rank of 3.7. No respondent found the situation either Excellent or Hopeless. The p-value for the organizations comparison is small enough to reject the null hypothesis of homogeneity (Table 23).

Table 23. Cross-Servicing Situation

	RANKS										MEAN RANK	STANDARD DEVIATION	MODE
	1	2	3	4	5	6	7	8	9	10			
COUNTS	0	9	18	9	12	4	0				3.7	1.2	3
PERCENTS	0	17	35	17	23	8	0						

Table 23. Cross-Servicing Situation (Continued)

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
RANK-SUM	1.05	0.30	YES	CIVILIAN/MILITARY
RANK-SUM	1.30	0.19	YES	EUROPE/AMERICA
KRUSKAL W	14.82	0.02	NO	ORGANIZATION
KRUSKAL W	1.60	0.66	YES	REGION

	SPEARMAN RANK CORRELATIONS, CORRECTED FOR TIES						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	-0.25	1.00					
COOP	-0.23	0.10	1.00				
NATO	0.07	0.68	0.70	1.00			
MANUF	0.37	0.11	0.66	0.53	1.00		
ENG	-0.75	-0.34	0.43	0.10	0.81	1.00	
AUX	0.72	0.44	0.69	0.13	0.46	0.71	1.00

The correlation coefficient for the subpopulation aircraft manufacturers-engine manufacturers is larger than 0.80, and four more pairs are larger than 0.70 (Table 23).

National Priority Given to the Solution.

Considering that the respondents to this question were only those who found the cross-servicing situation worse than neutral, the number of answers is small and the results have only limited value. The priority given to the solution seems to be neutral (mean rank of 4.07) as well as the mode.

Table 24. National Priority Given to the Solution

	RANKS										MEAN RANK	STANDARD DEVIATION	MODE
	1	2	3	4	5	6	7	8	9	10			
COUNTS	0	2	2	5	3	2	0				4.1	1.2	4
PERCENTS	0	14	14	36	21	14	0						

Table 24. National Priority Given to the Solution (Cont.)

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
RANK-SUM	0.92	0.36	YES	CIVILIAN/MILITARY
RANK-SUM	1.34	0.18	YES	EUROPE/AMERICA
not	enough	data	to compare	ORGANIZATION
"	"	"	" "	REGION

The standard deviation is larger than the rank interval. There is not enough evidence to reject the null hypothesis of homogeneity for any of the subpopulations (Table 24).

Frequency of Cross-Servicing Utilization.

Considering that the respondents to this question were only those who knew about the concrete data, the number of an-

swers is small and the results have only limited value. The frequency of cross-servicing utilization seems to be high (mean rank of 5.1) and the mode is more than 70 times per year (7 out of 9 respondents, from the Central Regions). The standard deviation is more than double the rank interval which means dispersed data. The test of homogeneity was meaningless for this variable because it related a question only to be answered by those addressees who knew the approximate number of cross-servicing utilization (Table 25).

Table 25. Frequency of Cross-Servicing Utilization

	RANKS										MEAN	STANDARD	MODE
	1	2	3	4	5	6	7	8	9	10	RANK	DEVIATION	
COUNTS	1	1	1	0	0	1	9				5.1	2.1	7
PERCENTS	8	8	8	0	0	8	69						

Section 4. Causes of Cross-Servicing Problem. The purpose of this section was to discriminate the perceived causes underlying the situation and the responsibility attributed to the different organizations involved in the problem solution.

Causes of Cross-Servicing Problem. This subsection was further subdivided into three groups: political, economic, and military.

Political 1: National vs. Common Defense. The results appear spread across the ranks, with a maximum on the first rank not much higher than the second and third ranks,

and a long right tail, which is responsible for the median-mode difference. None of the ranks received more than 30 % of the responses, which means high data dispersion. According with the p-values, there is not enough evidence to reject the null hypothesis of homogeneity for any of the subpopulations (Table 26).

Table 26. National vs. Common Defense

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	12	9	8	7	3	2	2	0	1		2	1
PERCENTS	27	20	18	16	7	5	5	0	2			

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.71	0.87	YES	CIVILIAN/MILITARY
	0.60	0.96	YES	EUROPE/AMERICA
	0.78	0.85	YES	ORGANIZATION
	0.32	0.57	YES	REGION

Political 2: Differences Europe-America. The results form a flat distribution with a maximum on the second rank and a long right tail, which is responsible for the median-mode difference. The percents are all under 22 % . Once again, the p-value for the organizations subpopulation is small enough to reject the null hypothesis of homogeneity. The pair of subpopulations cooperative programs-NATO bodies. with a coefficient of concordance as high as 0.80 , among others, is responsible for the high CHI-SQUARE statistic (Table 27).

Table 27. Differences Europe-America

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	8	11	5	5	8	9	1	1	1		4	2
PERCENTS	16	22	10	10	16	18	2	2	2			

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
Chi-SQR	1.78	0.62	YES	CIVILIAN/MILITARY
	3.97	0.41	YES	EUROPE/AMERICA
	9.39	0.02	NO	ORGANIZATION
	1.04	0.31	YES	REGION

	COEFFICIENT OF CONCORDANCE						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	0.36	1.00					
COOP	0.43	0.31	1.00				
NATO	0.46	0.39	0.82	1.00			
MANUF	0.33	0.52	0.52	0.64	1.00		
ENG	0.48	0.60	0.52	0.53	0.57	1.00	
AUX	0.38	0.20	0.54	0.51	0.31	0.42	1.00

Economic 1: National Industry Protection. The results are clearly concentrated on the first rank with a value more than three times the next rank. The mode and the median are both on rank one. None of the p-values is small enough to reject the null hypothesis of homogeneity.

Table 28. National Industry Protection

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	31	9	7	2	0	0	1	0	1		1	1
PERCENTS	61	18	14	4	0	0	2	0	2			

Table 28. National Industry Protection (Continued)

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	1.94	0.58	YES	CIVILIAN/MILITARY
	2.02	0.57	YES	EUROPE/AMERICA
	2.89	0.41	YES	ORGANIZATION
	0.13	0.41	YES	REGION

Economic 2: Employment Protection. The distribution of results has two high points in the second and fifth ranks, which means divided opinions, with the median and the mode one rank apart. None of the p-values is small enough to reject the null hypothesis of homogeneity (Table 29).

Table 29. Employment Protection

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	2	10	7	5	12	5	0	0	1		4	5
PERCENTS	5	24	17	12	29	12	0	0	2			

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	5.24	0.15	YES	CIVILIAN/MILITARY
	2.39	0.49	YES	EUROPE/AMERICA
	4.11	0.25	YES	ORGANIZATION
	0.01	0.92	YES	REGION

Military 1: Armament Self-Sufficiency. The results are concentrated around the third and fourth ranks, with long tails and dispersed percent values. None of the p-values is small enough to reject the null hypothesis of homogeneity for any of the comparisons (Table 30).

Table 30. Armament Self-Sufficiency

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	2	7	12	11	3	5	1	3	1		4	3
PERCENTS	5	16	27	24	7	11	2	7	2			

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	7.51	0.06	YES	CIVILIAN/MILITARY
	2.59	0.46	YES	EUROPE/AMERICA
	4.02	0.26	YES	ORGANIZATION
	0.38	0.54	YES	REGION

Military 2: Power Projection. The results are concentrated around the fifth and sixth ranks with double value (14 and 12) than the next rank of 6 counts on rank fourth. The distribution skewed to the left justifies the median-mode difference. None of the null hypothesis of homogeneity is rejected for any of the comparisons (Table 31).

Table 31. Power Projection

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	2	1	6	12	14	2	2	3		5	6
PERCENTS	0	5	2	14	29	33	5	5	7			

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	5.72	0.13	YES	CIVILIAN/MILITARY
	1.29	0.73	YES	EUROPE/AMERICA
	2.48	0.48	YES	ORGANIZATION
	0.86	0.35	YES	REGION

Other Responses. Here again a fruitful set of answers shows the multiplicity of concerns among the respondents. However related among themselves the answers are, none of them individually gathered enough support to be considered a significant cause in itself.

Responsibility for the Cross-Servicing Situation. This subsection addresses the perceived responsibility incurred by the different logistics organizations in the present situation of cross-servicing.

National Air Forces. The values for this organization are concentrated on the fist rank with double value (18) than the next rank (9). However, the long right tail is responsible for the median-mode difference. For the regions comparison, the null hypothesis of homogeneity is rejected. The correlation coefficients for every pair of subpopulations is higher than 0.50, and it is higher than 0.70 for the America-Southern Regions comparison (Table 32).

Table 32. National Air Forces

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	18	9	7	8	2	2	1	2	2	1	2	1
PERCENTS	35	17	13	15	4	4	2	4	4	2		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	4.22	0.52	YES	CIVILIAN/MILITARY
	3.80	0.43	YES	EUROPE/AMERICA
	3.12	0.80	YES	ORGANIZATION
	9.24	0.03	NO	REGION

Table 32. National Air Forces (Continued)

	COEFFICIENT OF CONCORDANCE			
	NORTH	CENTRAL	SOUTH	AMERICA
NORTH	1.00			
CENTRAL	0.50	1.00		
SOUTH	0.64	0.63	1.00	
AMERICA	0.67	0.67	0.77	1.00

Departments of Defense. The results for this organization are concentrated around the first and second ranks. With regard to the preceding organization, although the National Air Forces have the highest first rank value, and a mode of 1, the Departments of Defense receive the highest value adding the two first ranks. Both median and mode are on the second rank. The p-values are not small enough to reject the null hypothesis of homogeneity for any of the comparisons (Table 33).

Table 33. Departments of Defense

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	13	18	7	3	4	3	1	1	0	0	2	2
PERCENTS	26	36	14	6	8	6	2	2	0	0		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	4.70	0.32	YES	CIVILIAN/MILITARY
	6.43	0.27	YES	EUROPE/AMERICA
	4.18	0.65	YES	ORGANIZATION
	7.32	0.06	YES	REGION

NATO Military Bodies. The results for this organization are concentrated around the three first ranks with a maximum in the third rank. Although the National Air Forces have the highest first rank value, and a mode of 1, the NATO Military Bodies receive the highest value adding the three first ranks values. There is no difference between the mode and the median. The p-values are not small enough to reject the null hypothesis of homogeneity for any of the comparisons (Table 34).

Table 34. NATO Military Bodies

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	10	10	13	5	3	3	2	3	0	2	3	3
PERCENTS	20	20	25	10	6	6	4	6	0	4		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	4.80	0.31	YES	CIVILIAN/MILITARY
	9.21	0.16	YES	EUROPE/AMERICA
	8.42	0.21	YES	ORGANIZATION
	4.30	0.23	YES	REGION

NATO Civilian Bodies. The results for this organization go far from the first ranks presenting an undefined, flat distribution with three modes in the ranks 4, 5, and 7. The p-values are not small enough to reject the null hypothesis of homogeneity for any of the comparisons, in fact those values are very high for the civilian/military and region comparisons (Table 35).

Table 35. NATO Civilian Bodies

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	2	3	4	8	8	5	8	7	3	0	5	TRIMOD
PERCENTS	4	6	8	17	17	10	17	15	6	0		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	1.52	0.91	YES	CIVILIAN/MILITARY
	7.87	0.25	YES	EUROPE/AMERICA
	10.03	0.12	YES	ORGANIZATION
	0.25	0.97	YES	REGION

Cooperative Programs. The counts for this organization show again a flat distribution with heavy tails and maximum percent of 19 % on the fifth rank. The p-value for the organizations subpopulation is small enough to reject the null hypothesis of homogeneity. The NATO Bodies and Auxiliary Equipment subpopulations have the highest coefficient of concordance (Table 36).

Table 36. Cooperative Programs

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	4	6	8	9	2	7	6	5	0	5	5
PERCENTS	2	8	13	17	19	4	15	1	1	0		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	10.63	0.10	YES	CIVILIAN/MILITARY
	7.07	0.31	YES	EUROPE/AMERICA
	14.34	0.02	NO	ORGANIZATION
	1.66	0.65	YES	REGION

Table 36. Cooperative Programs (Continued)

	COEFFICIENT OF CONCORDANCE						
	AF	DOD	COOP	NATO	MANUF	ENG	AUX
AF	1.00						
DOD	0.18	1.00					
COOP	0.44	0.24	1.00				
NATO	0.48	0.20	0.51	1.00			
MANUF	0.30	0.51	0.32	0.43	1.00		
ENG	0.32	0.52	0.44	0.29	0.45	1.00	
AUX	0.49	0.33	0.63	0.42	0.43	0.40	1.00

Aircraft Manufacturers and Assemblers. The counts for this organization present a well defined distribution, with 74 % of the counts concentrated on the 4th, 5th and 6th ranks, but skewed toward the lower ranks, which accounts for the moderate difference between the mode and the median. The p-values are not small enough to reject the null hypothesis of homogeneity for any of the comparisons. (Table 37).

Table 37. Aircraft Manufacturers and Assemblers

	RANKS											
	1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
COUNTS	3	3	3	7	11	16	1	2	0	0	5	6
PERCENTS	7	7	7	15	24	35	2	4	0	0		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	8.88	0.06	YES	CIVILIAN/MILITARY
	3.13	0.21	YES	EUROPE/AMERICA
	11.03	0.09	YES	ORGANIZATION
	0.43	0.93	YES	REGION

Engine and Engine Parts Manufacturers. The counts for this group also present a well defined distribution with values concentrated around the 6th and 7th ranks, but skewed toward the lower ranks too, so that the median is smaller than the mode. The p-values are not small enough to reject the null hypothesis of homogeneity for any of the comparisons (Table 38).

Table 38. Engine and Engine Parts Manufacturers

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	2	3	5	8	11	14	3	1	0	6	7
PERCENTS	0	4	6	11	17	23	30	6	2	0		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	3.68	0.30	YES	CIVILIAN/MILITARY
	1.61	0.45	YES	EUROPE/AMERICA
	7.15	0.31	YES	ORGANIZATION
	0.97	0.81	YES	REGION

Aircraft Parts and Auxiliary Equipment. The counts for this level of aeronautical industry also present a well defined distribution with values concentrated around the 8th rank, but skewed toward the lower ranks with a heavy left tail including 28 % of the answers on the first five ranks, which is reflected by the median-mode difference. None of the p-values is large enough to reject the null hypothesis of homogeneity for any of the comparisons among the different subpopulations (Table 39).

Table 39. Aircraft Parts and Auxiliary Equipment

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	2	6	2	3	6	9	16	1	1	7	8
PERCENTS	0	4	13	4	7	13	20	35	2	2		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	3.01	0.38	YES	CIVILIAN/MILITARY
	0.65	0.96	YES	EUROPE/AMERICA
	5.56	0.47	YES	ORGANIZATION
	0.69	0.87	YES	REGION

Other Related Industries. The values for this subgroup also present a well defined distribution, with 63 % of the values on the 9th rank. The median and mode are both on the ninth rank, with a maximum seven times the next rank value. Only the p-value for the regions comparison is small enough to reject the homogeneity test where the coefficient of concordance for the central vs. south is 0.61 (Table 40).

Table 40. Other Related Industries

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	0	2	2	1	2	3	4	27	2	9	9
PERCENTS	0	0	5	5	2	5	7	9	63	5		

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.62	0.73	YES	CIVILIAN/MILITARY
	5.66	0.06	YES	EUROPE/AMERICA
	4.60	0.60	YES	ORGANIZATION
	8.85	0.03	NO	REGION

Table 40. Other Related Industries (Continued)

	COEFFICIENT OF CONCORDANCE			
	NORTH	CENTRAL	SOUTH	AMERICA
NORTH	1.00			
CENTRAL	0.44	1.00		
SOUTH	0.37	0.61	1.00	
AMERICA	0.37	0.46	0.41	1.00

Due to the length of the questionnaire, the availability of responses did not allow the performance of the detailed statistical tests for all the concepts and subpopulations, so that for the following questions the tests were only performed for each of the subpopulations, for all the concepts together.

Section 5. Impact of Cross-Servicing Problems. This section was further subdivided into two subsections: the areas where cross-servicing deficiencies will have the greatest impact, and the subsystems which will produce the most benefits from the correction of cross-servicing deficiencies.

Areas of Greatest Impact. The purpose of this subsection was to inquire the logistics areas where cross-servicing deficiencies have the greatest impact. The results in this subsection were ranked altogether in two categories, peacetime and wartime.

The statistical homogeneity comparisons for this section are depicted in Table 41, and none of the p-values is small enough to reject the null hypothesis of homogeneity at the 0.05 level of significance.

Table 41. Areas of Cross-Servicing Problem Impact

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.06	0.81	YES	CIVILIAN/MILITARY
	0.93	0.33	YES	EUROPE/AMERICA
	1.65	0.95	YES	ORGANIZATION
	7.27	0.06	YES	REGION

Peacetime 1. NATO Exercises. The values for this subsection are concentrated around the first rank, although a heavy right tail, with a second relative maximum on the 6th rank, is responsible for the difference between the median and the mode (Table 42).

Table 42. Impact on NATO Exercises

	RANKS											
	1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
COUNTS	21	2	1	2	5	6	4	3	1	0	2	1
PERCENTS	47	4	2	4	11	13	9	7	2	0		

Peacetime 2. Visiting Country. The values for this subsection are spread throughout the ranks, with two humps in ranks 2 and 7. This distribution is responsible for the big difference between the mean and the mode (Table 43).

Table 43. Impact as Visiting Country

	RANKS											
	1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
COUNTS	6	12	2	4	4	0	11	6	1	1	4	2
PERCENTS	13	26	4	9	9	0	23	13	2	2		

Peacetime 3. Receiving Country. This subsection presents similar characteristics to the preceding one, but still more defined with three groups of answers around ranks three, six, and eight. This distribution is responsible for the large median-mode difference (Table 44).

Table 44. Impact as Receiving Country

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	5	11	0	4	6	0	12	5	0	6	8
PERCENTS	2	11	25	0	9	14	0	27	11	0		

Wartime 1. Reinforcement Plans. The values for this subsection appear concentrated around the four initial r but still skewed to the right which produces a moderate i- ode difference, although smaller that the preceding concept (Table 45).

Table 45. Impact on Reinforcement Plans

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	7	12	11	9	3	3	1	2	0	0	3	2
PERCENTS	15	25	23	19	6	6	2	4	0	0		

Wartime 2. Prepositioning. The values for this subsection appear mainly spread across the five initial ranks which produces a moderate median-mode difference (Table 46).

Table 46. Impact on Prepositioning

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	8	11	6	8	8	3	1	2	0	0	3	2
PERCENTS	17	23	13	17	17	6	2	4	0	0		

Wartime 3. Resupply. The values for this subsection present a hump about the four initial ranks which produces a bimodal distribution with dispersed percents and variable median-modes difference (Table 47).

Table 47. Impact on Resupply

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	6	9	9	8	4	4	3	2	0	0	4	BIMODE
PERCENTS	13	20	20	18	9	9	7	4	0	0		

Wartime 4. Battle Damage Repair. The values for this subsection appear spread throughout the ranks with a flat distribution. Because of it, the difference between the median and the mode is only moderate (Table 48).

Table 48. Impact on Battle Damage Repair

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	6	6	7	3	9	4	6	2	1	0	6	5
PERCENTS	14	14	16	7	20	9	14	5	2	0		

Wartime 5. Hardened Airbase Environment. The values for this subsection appear spread throughout the ranks with a flat distribution and long tails. Because of it, the median-mode difference is moderate (Table 49).

Table 49. Impact on Hardened Airbase Environment

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	0	4	6	9	7	6	4	6	1	6	5
PERCENTS	2	0	9	14	20	16	14	9	14	2		

Other Responses. Not many answers were collected about the open ended question; however it appears that the 'impact of cross-servicing deficiencies on NATO airpower' should be considered as a separate question as it deserved such consideration by three respondents.

Benefits From the Correction of Deficiencies. The purpose of this subsection is to determine the logistics subsystems, among those which greater impact have upon cross-servicing, which would benefit most from the correction of cross-servicing deficiencies.

The statistical homogeneity comparisons for this section are depicted in Table 50. The p-values are rather high for all the comparisons, specially among the organizations subpopulation and do not justify the rejection of the homogeneity tests.

Table 50. Benefits From the Correction of Deficiencies

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.01	0.91	YES	CIVILIAN/MILITARY
	0.17	0.68	YES	EUROPE/AMERICA
	1.30	0.97	YES	ORGANIZATION
	0.83	0.84	YES	REGION

Armament. The values for this subsection appear concentrated around the first rank but with a long, heavy tail to the right which is responsible for the median-mode difference (Table 51).

Table 51. Benefits on Armament from Deficiencies Correction

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	18	10	6	6	3	3	0	2	1	0	2	1
PERCENTS	37	20	12	12	6	6	0	4	2	0		

Replenishment. The values for this subsection appear concentrated around the second rank with the median and mode both on the second rank (Table 52).

Table 52. Benefits on Replenishment from Deff. Correction

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	10	18	7	2	4	4	0	2	1	0	2	2
PERCENTS	21	38	15	4	8	8	0	4	2	0		

Emergency Supply. The results for this subsection appear spread across the ranks, but with a high maximum on the third rank which attracts median and mode (Table 53).

Table 53. Benefits on Emergency Supply from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	6	5	13	2	6	5	5	4	1	0	3	3
PERCENTS	13	11	28	4	13	11	11	9	2	0		

Test Equipment. The values for this subsection appear spread across the ranks, with a clear hump around the mode. The distribution is skewed to the right but not enough to separate the mode from the median (Table 54).

Table 54. Benefits on Test Equipment from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	5	6	13	6	8	7	1	1	0	4	4
PERCENTS	2	10	13	27	13	17	15	2	2	0		

Load Equipment. The values for this subsection appear spread across the ranks, with a clear hump to the right of the median and a flat, trimodal, undefined distribution. These are all symptoms which correspond to an intermediate weight for the concept but with no single, clear rank to be assigned to the load equipment (Table 55).

Table 55. Benefits on Load Equipment from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	7	8	5	6	8	8	1	0	0	5	TRIMOD
PERCENTS	2	16	19	11	14	19	19	2	0	0		

Personnel Training. The values for this question are concentrated around the fourth and fifth ranks, but with heavy tails on both sides (Table 56).

Table 56. Benefits on Personnel Training from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	5	4	5	11	11	6	5	1	0	0	4	BIMODE
PERCENTS	10	8	10	23	23	13	10	2	0	0		

Material Policies. The values for this subsection appear spread throughout the ranks, with a neat top on the eighth rank, although the percents show a moderate dispersion. The distribution presencs a heavily ended left tail, which explains the median-mode difference (Table 57).

Table 57. Benefits on Material Policies from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	4	2	4	2	3	1	9	16	3	1	7	8
PERCENTS	9	4	9	4	7	2	20	36	7	2		

Technical Publications. The values for this distribution are spread across the ranks, with a hump around the eight and ninth ranks, and a long left tail, which accounts for the median-modes difference (Table 58).

Table 58. Benefits on Tech. Publications from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	1	3	5	6	6	5	9	9	1	7	BIMODE
PERCENTS	2	2	7	11	13	13	11	20	20	2		

Shelters. The values for this subsystem present a fairly well concentrated distribution around the median-mode on rank 9, with a light, short left tail (Table 59).

Table 59. Benefits on Shelters from Deff. Corr.

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	0	0	0	1	5	4	8	24	3	9	9
PERCENTS	0	0	0	0	2	11	9	18	53	7		

Other Responses. The responses to the open question were few and far between, and none of them received enough support to be considered as a separate question.

Section 6. Cross-Servicing Problem Solutions. This section was further subdivided into four subsections; the cross-servicing subsystems which represent the best opportu-

nity for improved RSI, the role that logistics organizations have to play to solve the cross-servicing problem, the type of cooperative program which was believed to help solve the diversity of weapon system within NATO, and the level of aeronautical industry which would have to diversify or redirect its production to cope with the contraction of defense markets.

Opportunity of Subsystems for Improved RSI. The purpose of this subsection was to cross-check the validity of the answers expressed in the preceding page in the questionnaire, as the opportunity for improved RSI should be closely related to the benefits from the correction of deficiencies on the same cross-servicing subsystems. Both questions served their purpose as they showed that the undefined distributions of the first question did not coincide with those expressed about the second question, except from the answers to the armament and shelters subsystems, which again were clearly considered as first and last subsystems respectively.

None of the p-values is small enough to reject the hypothesis of homogeneity among any of the subpopulations; furthermore the levels of significance are very high (Table 60).

Table 60. Opportunity For Improved RSI

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.04	0.85	YES	CIVILIAN/MILITARY
	0.00	0.96	YES	EUROPE/AMERICA
	0.02	0.99	YES	ORGANIZATION
	0.02	0.99	YES	REGION

Armament. The counts for this subsection show a distribution with a clearly defined top on the first rank, a lower hump on rank seventh, and a long right tail which accounts for the large median-mode difference (Table 61).

Table 61. Opportunity of Armament for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	20	3	4	5	3	7	3	2	2	0	3	1
PERCENTS	41	6	8	10	6	14	6	4	4	0		

Replenishment. The values for this subsection show an undefined distribution, with a primary hump around the second rank, and a lower hump around the seventh, so that the median falls on the second lower rank. A long, heavy right tail which accounts for the large median-mode difference (Table 62).

Table 62. Opportunity of Replenishment for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	8	9	6	2	2	4	7	5	4	0	4	2
PERCENTS	17	19	13	4	4	9	15	11	9	0		

Emergency Supply. The values for this subsection show a flat distribution with the mode slightly differentiated on the sixth rank and a heavy left tail, although the median-mode difference is only moderate (Table 63).

Table 63. Opportunity of Emergency Supply for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	4	5	5	7	6	9	2	6	1	1	5	6
PERCENTS	9	11	11	15	13	20	4	13	2	2		

Test Equipment. The values for this subsection show a hump around the mode on the fifth rank, with a distribution skewed to the left. The median-mode difference is moderate (Table 64).

Table 64. Opportunity of Test Equipment for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	3	7	8	7	10	5	3	3	1	0	4	5
PERCENTS	6	15	17	15	21	11	6	6	2	0		

Load Equipment. The values for this subsection present a fairly flat distribution beyond the mode, which looks like if the distribution were merely a long, heavy right tail. It explains the high median-mode difference (Table 65).

Table 65. Opportunity of Load Equipment for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	12	7	7	8	1	8	3	1	0	4	2
PERCENTS	0	26	15	15	17	2	17	6	2	0		

Personnel Training. The values for this subsection are concentrated around the third rank with a long right tail, which accounts for the moderate median-mode difference (Table 66).

Table 66. Opportunity of Personnel Training for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	4	4	12	6	6	5	6	5	0	0	4	3
PERCENTS	8	8	25	13	13	10	13	10	0	0		

Material Policies. The values for this subsection are spread throughout the ranks with a bimodal distribution and a flat, heavy left tail, which accounts for the undefined median-mode difference (Table 67).

Table 67. Opportunity of Material Policies for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	5	7	2	4	3	8	7	8	2	0	6	BIMODE
PERCENTS	11	15	4	9	7	17	15	17	4	0		

Technical Publications. The values for this subsection are spread throughout the ranks with a flat distribution which indicates undefined opinions, and a long, heavy right tail. However, the median -mode differe ·e is only moderate (Table 68).

Table 68. Opportunity of Technical Publications for Imp.RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	3	2	7	8	6	5	5	5	4	0	5	4
PERCENTS	7	4	16	18	13	11	11	11	9	0		

Shelters. The values for this subsystem present a fairly well defined distribution around the ninth rank, and according to this characteristic, there is no median-mode difference (Table 69).

Table 69. Opportunity of Shelters for Improved RSI

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	1	0	1	1	1	3	8	23	3	9	9
PERCENTS	0	2	0	2	2	2	7	20	56	7		

Other Responses. Only one among the small number of answers to the open ended question deserves some consideration to be included as a separate question. The solution for the diversity of aircraft types was regarded by two respondents as presenting a high opportunity for improved RSI within NATO.

Organizations' Role in the Solution of the Problem. The aim of this subsection was to distinguish between the logistics organizations' responsibility for the present situation and the logistics organizations' role in the cross-

servicing problem solution. Logically, both concepts should be closely related. However, according to the answers to this question, organizations do not appear ranked in the same order in both subsections. A plausible explanation for this fact could be that the organizations which set up the weapon systems requirements do not have the control over the resources necessary to materialize those pure military requirements into actual weapon systems. Still those organizations are blamed for letting politics trade-off political-economic reasons against military requirements.

The results of the statistical comparisons for the homogeneity test among the different populations is showed in Table 70, where there can be observed the highest levels of agreement among subpopulations.

Table 70. Organizations' Role in the Problem Solution

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.00	0.95	YES	CIVILIAN/MILITARY
	0.01	0.91	YES	EUROPE/AMERICA
	0.09	0.99	YES	ORGANIZATION
	0.03	0.95	YES	REGION

National Air Forces. The results of this subsection are concentrated around the first four ranks, and compared to what appeared in the section 4 about the organizations, now the National Air Forces have the mode on the third rank among the roles in the problem solution, whereas in section 4 the Air Forces were considered as the first

responsible among the logistics organizations. There is no median-mode difference (Table 71).

Table 71. Air Forces Role in the Problem Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	10	7	16	10	2	0	0	3	2	1	3	3
PERCENTS	20	14	31	20	4	0	0	6	4	2		

Departments of Defense. The results of this subsection are concentrated around the first three ranks and according to what appeared in the preceding question about organizations, here the Departments of Defense have the mode on the first rank, whereas in section 4 the Departments of Defense were considered as the second responsible among the logistics organizations. The median-mode difference is moderate (Table 72).

Table 72. Departments of Defense Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	19	13	10	3	2	1	0	2	0	0	2	1
PERCENTS	38	26	20	6	4	2	0	4	0	0		

NATO Military Bodies. The results of this subsection show that the Departments of Defense and the NATO Military Bodies share the first place among the logistics

organizations' role in the problem solution. However, the former's distribution appears more concentrated around the first ranks (Table 73).

Table 73. NATO Military Bodies Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	17	14	7	3	3	3	1	0	1	1	2	1
PERCENTS	34	28	14	6	6	6	2	0	2	2		

NATO Civilian Bodies. The clear definition of the three preceding distributions gets loose in this organization with spread out values, and a long, heavy right tail. However, there is no median-mode difference (Table 74).

Table 74. NATO Civilian Bodies Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	8	8	11	7	3	5	1	4	1	4	4
PERCENTS	2	16	16	22	14	6	10	2	8	2		

Cooperative Programs. The characteristics of this distribution are quite similar to the preceding one, but with a smaller dispersion of values and a higher concentration on the fourth and fifth ranks which means better defined opinions among the survey respondents. There is no median-mode difference (Table 75).

Table 75. Cooperative Programs Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	3	6	15	13	2	4	3	1	0	4	4
PERCENTS	2	6	13	31	27	4	8	6	2	0		

Aircraft Manufacturers and Assemblers. This is a well defined distribution with the values concentrated around the median-mode rank and light tails, which do not separate the median from the mode (Table 76).

Table 76. Aircraft Manufacturers Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	0	1	2	7	19	10	6	1	0	6	6
PERCENTS	2	0	2	4	15	40	21	13	2	0		

Engine and Engine Parts Manufacturers. This is a well defined distribution with the values concentrated around the mode rank, but with a long left tail which accounts for the median-mode difference (Table 77).

Table 77. Engine Manufacturers Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	2	1	3	8	11	17	5	0	0	6	7
PERCENTS	2	4	2	6	17	23	35	10	0	0		

Aircraft Parts and Auxiliary Equipment. This is a well defined distribution with the values concentrated around the mode, but with a long left tail which accounts for the median-mode difference (Table 78).

Table 78. Parts and Auxiliary Equipment Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	1	1	1	6	6	7	20	3	0	7	8
PERCENTS	2	2	2	2	13	13	15	43	7	0		

Other Related Industries. Given the diversity of organizations involved in the problem, and the multiple forms of describing them, the purpose of this second open ended question was to distinguish between the role played by other related and unrelated industries in the problem solution. This is a well defined distribution with the values concentrated around the mode, but with a light left tail. There is no median-mode difference (Table 79).

Table 79. Other Related Industries Role in the Solution

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	0	1	1	1	3	2	7	28	1	9	9
PERCENTS	0	0	2	2	2	7	5	16	64	2		

Other Responses. Only three answers were included in this section, but one of them was considered important enough to be included as a separate organization: the national governments. Weapon systems are so important in national politics that armament business goes beyond the narrow limits of DOD departments and is contemplated more as an issue for the whole government.

Cooperative Programs to Solve Diversity of Weapon Systems. The purpose of this subsection was to rank the different modalities of cooperative programs, in the form of perceived preference among the different decision-making organizations, as an indication of the way ahead for weapon system collaboration within the NATO Alliance.

The results of the statistical comparisons for the homogeneity test among the different populations is showed in Table 80. There can be realized the very high levels of agreement among subpopulations.

Table 80. Preference for Cooperative Programs

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.00	0.95	YES	CIVILIAN/MILITARY
	0.01	0.98	YES	EUROPE/AMERICA
	0.02	0.99	YES	ORGANIZATION
	0.05	0.93	YES	REGION

Codevelopment. The values for this cooperative program present a well defined distribution, highly concentrated around the first two ranks, and specially on the first

rank which is more than three times the next value. A short, light, right tail does not force any median-mode difference (Table 81).

Table 81. Preference for Codevelopment

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	32	10	2	4	2	0	0				1	1
PERCENTS	64	20	4	8	4	0	0					

Licensed Production. This distribution is skewed to the left and has a hump around the fourth rank with a mode on the fifth rank, what accounts for the moderate median-mode difference (Table 82).

Table 82. Preference for Licensed Production

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	4	5	13	12	14	3	0				4	5
PERCENTS	8	10	25	24	27	6	0					

Coproduction. The distribution for this for of cooperative programs is very similar to the distribution for codevelopment but with the mode on the second rank. Here again there is no median-mode difference and the values are fairly well concentrated as showed by 94 the percents lying on the three first ranks (Table 83).

Table 83. Preference for Coproduction

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	8	22	17	1	1	1	0				2	2
PERCENTS	16	44	34	2	2	2	0					

Packages. This distribution is very similar to the two preceding ones, but with the values concentrated on only four ranks, with the mode on the sixth rank and a somewhat heavier left tail, which accounts for the median-mode difference (Table 84).

Table 84. Preference for Packages

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	0	0	1	10	15	19	0				5	6
PERCENTS	0	0	2	22	33	42	0					

Family of Weapons. The values for this subdivision appear spread across the ranks with a heavy left tail account for a moderate median-mode difference (Table 85).

Table 85. Preference for Family of Weapons

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	7	8	11	12	7	2	1				3	4
PERCENTS	15	17	23	25	15	4	2					

Opening Defense Markets. The values for this subdivision are spread across the ranks with a distribution skewed to the left, which accounts for the moderate median-mode difference (Table 86).

Table 86. Preference for Opening Defense Markets

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	1	5	4	9	8	18	2				5	6
PERCENTS	2	11	9	19	17	38	4					

Other Responses. None of the responses to this open ended question deserved to be considered as a separate point in the questionnaire because of the lack of enough support.

Industry to Diversify or Redirect its Production. The purpose of this subsection was to appraise the ability to divert their production out of the aeronautical business that the different levels in the aeronautical industry have. In this industrial area with excess capacity of production, the ease with which existing firms would be able to get into new business, thus adapting to the contraction of the market, will impact on the balance of forces working for or against collaborative programs, and therefore on the level of RSI among the NATO member countries.

The results of the statistical comparisons for the homogeneity test among the different populations is showed in Table

83. There can be appreciated the very high levels of agreement among the different subpopulations (Table 87).

Table 87. Industry to Diversify or Redirect

TEST	STATISTIC	P-VALUE	HOMOGENEITY	POPULATIONS
CHI-SQR	0.08	0.77	YES	CIVILIAN/MILITARY
	0.07	0.80	YES	EUROPE/AMERICA
	0.01	0.99	YES	ORGANIZATION
	0.01	0.99	YES	REGION

Aircraft Manufacturers and Assemblers. The opinions among the respondents are divided as showed up by the double hump on ranks one and three, but with the value for the median-mode on rank one almost double than the rank three (Table 88).

Table 88. Redirect Aircraft Manufacturers and Assemblers

	RANKS											
	1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
COUNTS	29	6	15	1							1	1
PERCENTS	57	12	29	2								

Major Systems Manufacturers. The values for this distribution are fairly well concentrated around the mode on the second rank. with more than double the next rank value, and no median-mode difference. Besides, this branch of the aeronautical industries presents the highest concentration of responses on a single rank which reflects a fairly well defined opinion among the respondents.

Table 89. Redirect Major Systems Manufacturers

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	13	31	5	0							2	2
PERCENTS	27	63	10	0								

Aircraft Parts and Auxiliary Equipment. The values for this distribution are concentrated around the mode on the third rank with 40 % of the answers advocating for a smaller rank. There is no median-mode difference (Table 90).

Table 90. Redirect Aircraft Parts and Auxiliary Equipment

	RANKS										MEDIAN	MODE
	1	2	3	4	5	6	7	8	9	10		
COUNTS	8	12	29	0							3	3
PERCENTS	16	24	59	0								

Other Responses. No answer to this open ended question deserved to be considered as a separate point in the questionnaire because of the lack of enough support.

Conclusion

If any, the characteristic that applies to the several organizations surveyed is the diversity and lack of agreement, both among and within the organizations themselves. Only 6 questions out of 77 in the survey showed an agreement greater than 60 % on the same rank (Table 91), and 7 out of

Table 91. Measure of Dispersion of Survey Responses

MEASURE OF DISPERSION								
TOTAL	AGREEMENT ON THE SAME RANK							
100%	0-10%	10-19%	20-29%	30-39%	40-49%	50-59%	60-69%	>70%
77	0	5	25	25	7	9	6	0

12 homogeneity tests rejected were due to the organizations comparison, which on the other hand means that in general there is a good level of agreement between the responses coming from the civilian and military subpopulations, and between the responses coming from the continents subpopulations as well (Table 92). However, both agreement and dis-

Table 92. Homogeneity Tests Rejected

HOMOGENEITY TESTS REJECTED				
TOTAL	ORGANIZATIONS	REGION	CIVILIAN/MILITARY	CONTINENT
12	7	4	1	0

agreement make it possible to achieve conclusions and answer the questions which are the object of this work about cross-servicing.

V. Discussion

Introduction

This chapter provides a discussion of the study's findings, some limitations experienced in the research, and the conclusions drawn from those findings. The author's recommendations for follow-on research conclude the chapter.

Findings

As a short review of the intended purpose of this research work before the findings are presented, it was assumed at the beginning that new political, economic, and military environmental conditions in NATO situation, added to already long standing ones have produced among the armed forces of the NATO member countries a state of increased force requirements with reduced defense budgets. Under these circumstances, the best use of the available resources through RSI will become vital. The present diversity of types of aircraft among the air forces has made the situation of cross-servicing, an essential part of RSI, far from ideal, and because of the preceding circumstances is going to be worse.

A survey was used to answer the following questions:

1. which are the causes of the problem?

2. which organizations are responsible for the present situation and which ones have the power for its solution?

3. which are the areas and subsystems within cross-servicing which experienced the greatest impact and offer the greatest opportunity for improvement?

4. which is the most likely future for cooperative programs and different levels within the aeronautical industry as a key solution for the diversity of aircraft?

The opinions gathered with the survey were summarized in the preceding section and lead to the following findings.

Section 2. Environmental Perception. The answer to the research question about the perceived relative strength of the different environmental factors affecting the cross-servicing of aircraft, in a general sense, showed that there is a good level of consensus among the respondents on the importance of topics within each factor (political, economic, and military). There was also agreement on the low importance attributed to both the labor force pressure and the emergent technologies as relevant subfactors in the environment. Politics is considered as the driving force, followed by economics, and military factors.

Political. The number of respondents who agreed on the leading role of Perestroika and Glasnost upon NATO environment is only mirrored by the agreement on the low role played within the economic factor by the concern about jobs, often argued by politicians as a major consideration. These two subfactors represent both extremes of the environment continuum.

Such a clear preference for the first political subfactor dimmed the potential second subfactor which appears to be unclaimed in the survey answers. The third place among the political subfactors belongs to the INF Treaty on which, as could have been intuitively predicted, there was no agreement among the regions on the INF Treaty, these regions meaning the northern, central, and southern regions on the European side, plus America. Pacifism and terrorism share preference for the fourth rank, with the latter slightly obscured by a divided opinion about its importance. This last fact bears some implications with regard to the low level of concern about terrorism in spite of the high priority agreement of Turin where European anti-terrorist policies were unified. Moreover, there was no agreement among the organizations on this point, stressing the different perceptions about this international problem.

The interest expressed about the political consequences of what could be named 'European Community 92' received enough respondents' support to be considered as a significant factor omitted in the questionnaire. This topic should be included in follow-on research.

Economic. Increased weapon systems development cost is the most important among NATO economic subfactors. Competition on armaments international markets is in second place, and industry protectionism in third, although both present less defined responses. Industry protectionism was

perceived differently by the several organizations surveyed as could have been foreseen because this sensitive political topic is qualified differently by the industries than by the national defense organizations, with the international organizations in between. Labor force pressure stands in the unquestioned last place among the economic subfactors with a clarity only matched by the first place of Perestroika and Glasnost in the political factors.

Military. The first place among military subfactors is disputed between the conventional arms gap NATO/WP (which relates to the political INF Treaty), and the insufficient level of RSI, with preference for the former. Logistics as a national responsibility stands in the third rank, and finally the emergent technologies occupy a distinct last place, where again there was no agreement among the organizations subpopulation.

Top Five. Consistent with the relevance expressed in the preceding questions, the few valid responses to this query, less than 40 %, showed agreement on Perestroika and Glasnost, weapon system development costs, and conventional arms gap NATO/WP as the first three overall concerns within the NATO general environment. After these three factors came the insufficient level of RSI, at some distance competition on armaments international markets, and finally the INF Treaty .

Effects of Environmental Factors. The purpose of this question was to determine the perceived effects of the above environmental factors upon NATO logistics situation, specially on cross-servicing of aircraft within NATO.

Reduced Defense Budgets. The environmental factors have produced effects rated by the respondents between strongly negative and moderately negative upon the NATO countries' defense budgets, as was anticipated in Section 1 of this work. The dispersion of opinions was small, but there was no consensus among organizations' responses because of the disagreements within the defense organizations. and within their civilian aeronautical industry counterparts as well. Apparently, the size of defense budgets is considered differently from the prospective of those who allocate them than from the point of view of the ones who have to accomplish their mission within the tight budget constraints.

Increased Conventional Arms Gap NATO-WP. The reduction of defense budgets throughout the alliance does not seem to have resulted yet in an increase on the conventional arms gap between NATO and the WP. The effects in this area appear to be only slightly negative with lack of agreement among the regions as this problem is perceived differently by the northern and southern regions on one side, and the central region and America on the other.

Increased Force Requirements. Both preceding effects compounded should have led to an increase in the

force requirements within the Alliance as expanded missions have to be accomplished by reduced forces with fewer resources available. While the second intermediate effect of an increase on the conventional arms gap remains undefined, so does this third effect of increased force requirements, even closer to the null effects category than the other two.

The survey results on the three preceding effects could be interpreted as if there were only a partial connection among the overall environment factors and their final effects upon NATO logistics situation. In other words, the alliance has been already pushed toward the level of reduced defense budgets, although NATO has not achieved yet the level of increased conventional arms gap so that the force requirements have not yet increased significantly for the allied armed forces. It might be possible that the signing of treaties between the two sides of the iron curtain will become the preferred strategy to balance the equation of forces for both NATO and the Warsaw Pact.

Section 3. Cross-servicing Situation. To determine whether the above NATO logistics situation has actually resulted in a real cross-servicing problem, this section addressed the status of cross-servicing. If the situation was perceived any worse than neutral, the next question inquired about the priority given to solving the problem with regard to the other major issues within the organizations surveyed, to figure out what are the chances that the diver-

sity of aircraft will ever be reduced. Finally the frequency of cross-servicing utilization was asked to determine the true importance of the topic.

Cross-servicing Situation. The answers to this question were surprising for the author because the situation was more likely to be estimated good than poor, although with a big set of responses supporting the not satisfactory category. Moreover, this appraisal seems to be inconsistent with the rest of the questionnaire where a problematic situation was implied and received answers compatible with that assumption. It might be that the general situation is actually perceived as problematic, but when the subject comes to submit a judgement of value about a concrete system, people are not too inclined to give answers perceived as negative, specially those who are not directly involved in or affected by the problem, like the aeronautical industries. As could be easily predicted from the preceding results, there was no agreement among the organizations.

Priority Given to the Problem Solution. This concept refers to the importance given to the solution of the problem of cross-servicing within the different organizations as compared with other international issues. The lower number of responses to this question was due to the fact that it was only intended to be answered by those respondents who found the situation on the negative side of the scale. As such, the answer showed that the different organizations in charge

of the problem do not devote enough will and resources to its solution.

Frequency of Utilization. A major question to be on the basis of this research was whether cross-servicing of aircraft within NATO is believed to be a real issue, or else it is merely considered one more among the many plans developed for wartime but which have only the miscellaneous interest during peacetime of showing cooperative goodwill among the countries. According to the responses, the topic has enough importance to deserve the attention of logistics organizations within the alliance, specially within the Central Region, from where originate seven out of the nine responses ranked within the maximum level of cross-servicing utilization.

Section 4. Cross-servicing Problem Causes. The causes of the problem, along with the organizations responsible for the present situation, help in understanding the problem and in foreseeing the likelihood of a solution whenever those causes vanish or new circumstances overcome them. The economic 'national industry protection' stands in unchallenged first place among the causes with almost three times the number of responses than the next concept, the political 'national versus common defense.' After them, the opinions are not so clear. The differences between Europe and America in a political sense, in the third place, are followed by the nations' intent to achieve armament self-sufficiency, the

national employment protection, and power projection as the last cause. In general then, and opposed to the environmental political preeminence, here economic reasons have priority over political, and these have preference over the pure military causes in explaining the reasons for the cross-servicing problem. Logically, politics dominate over the high environmental factors, the causes in the middle are mainly economical, and the responsibility at the bottom lies on the military organizations.

Responsibility for the Cross-servicing problem. NATO countries' national air forces, departments of defense, and NATO military bodies, in that order, share the three first places among the organizations responsible for the present diversity of aircraft types within the NATO Alliance. Next, NATO civilian bodies, cooperative programs, and aircraft manufacturers and assemblers, appear grouped around an undefined fifth place. Then engine and engine parts manufacturers, and aircraft parts and auxiliary equipment manufacturers appear on the seventh and eighth ranks. Finally, in the undisputed and clearly defined last position, the other related industries. The problem then seems to be in military hands, specially at the national air forces level, and it is only attributed to economic levels in the second instance. Perhaps the military establishments are blamed in the first place for not pushing their requirements hard enough to the political and economic institutions and for compromising air

forces capabilities during the requirements definition phase and beyond for political and economic reasons.

The national governments' support for protectionism and subsidies, among the answers to the open ended question, received enough support to be considered as an independent point in follow-on research.

In short, the results of the last two questions should be interpreted in terms of cross-servicing as a primarily economic problem being in the hands of military organizations responsible for it.

Section 5. Impact of Cross-servicing Problem. Peacetime NATO exercises occupy the first allied logistics area affected by the problem deficiencies with the best defined distribution of responses within this section. Next come reinforcement plans in the second place, prepositioning in third, and the system users as a visiting country in fourth. The areas of resupply, battle damage repair, and hardened airbase environment follow around the sixth place. Finally, the users of the cross-servicing system in the role of receiving country closes the list of areas affected by the problem deficiencies.

The impact upon flexibility of forces received enough independent support to be considered as another point in follow-on research.

As a summary of this question, NATO exercises are most affected in peacetime. For the rest of the fields wartime-

related concepts showed greater importance. This qualification of cross-servicing among the wartime-related concepts helps explain the preeminence of economic reasons as actual, everyday worry, as opposed to doubtful, future wartime considerations. All the countries are more concerned about their role as visiting country than as receiving country because visiting countries benefit most from current cross-servicing capabilities which save resources and improve operability during deployed operations.

Benefits From the Correction of Deficiencies. The logistics area of armament seems to be the one which would benefit most from the improved RSI level within NATO. This result clearly confirms the preceding conclusion about the greater impact of cross-servicing deficiencies upon wartime logistics areas, for the first concern among NATO logisticians relates to a Stage B cross-servicing area. Furthermore, the second place is hold by a Stage A area, replenishment. Third and fourth belong to emergency supply and test equipment respectively. Personnel training occupies the fifth place, whereas material policies, load equipment and technical publications occupy the next places. And finally, NATO's infrastructure program seems to have paid its toll as NATO logisticians consider the area of shelters to be of the lowest concern as potential benefit from cross-servicing deficiencies correction.

All these facts indicate that NATO logisticians should concentrate on Stage B cross-servicing because the level achieved on Stage A passed it to a second place among management issues.

Section 6. Cross-servicing Problem Solutions. The purpose of this section was to arrive to a final conclusion from the preceding sections. On which areas, by which organizations, and in which way should the problem caused by the diversity of aircraft types upon cross-servicing within NATO be solved? Furthermore, to check the validity of this section, the first two questions were directed toward concepts closely related to previous questions. And to close the topic, which level within the aeronautical industry will be driven out of business by the contraction of defense markets?

Logistics Areas Opportunity for Improved RSI. The primary purpose of this question was to focus on the matters to be solved, while the secondary was to cross-check the results of the preceding question in the same area. Here armament was once again the logistics area with the highest likelihood to actually realize RSI improvements. Again, shelters appeared in last place among the concerns. Besides, the areas of load equipment and personnel training received better rankings than in the preceding question, whereas the rest of the areas showed more dispersed opinions, which could be attributed to the lack of confidence, thus agreement, on

any logistic area as potential domain for improved RSI and cross-servicing.

Organizations' Role in the Problem Solution. One of the most interesting findings of this research belongs to this area . While there was a good level of agreement on the National Air Forces as the first organization responsible for the present diversity of aircraft, surprisingly it is out of their hands to solve the problem. because the Departments of Defense, and NATO military bodies were considered to have the leading roles in this field. Again the NATO civilian bodies and the different levels in the aeronautical industry do not seem to have an important function to play. As explained before, the final decision during weapon systems procurement process lies in political hands insofar as they have been convinced by the military establishment of the right priority that the solution of this problem should have within the alliance member countries.

National governments among the answers received to the open ended question received enough support to be considered as an independent point in follow-on research and the reason for it might be the same as explained before. that is, the responsibility for resources allocation lies beyond the pure defense related organizations.

Cooperative Programs to Solve the Problem. Now this work arrives at the point where all the preceding considerations have to yield positive results in the way of a tangible

forecast about the future of cooperative solutions for the problem of diversity of aircraft within NATO. All the results agree with the theory of international cooperation expressed in the literature review section. Here those concepts, after being corroborated by a survey among the different decision-making organizations responsible for collaborative programs, have been quantified and proved by statistical analysis within very narrow probabilities of error, thus giving the conclusions more weight.

Codevelopment is the undisputed preferred cooperative solution followed by coproduction, both with pretty good levels of agreement on the responses. Every country wants to get as much as it can from the opportunity for shared technology that the highly prestigious aeronautical industry provides. Some answers reflect though that, unless the required industrial level is already available, codevelopment has its price and requires a high level of investment not always compensated by economic achievements. In those cases, coproduction was the preferred system. Licensed production and family of weapons in that order follow the list, while packages and opening defense markets are the least endorsed cooperative program solutions.

To summarize the most important of the preceding concepts, a forecast for the future would point at codevelopment as the most likely cooperative solution to succeed, although some reservations still endow coproduction with many opportunities

under certain conditions. Family of weapons, albeit a happy idea, does not seem to have a chance to play a decisive role in the international armaments cooperation arena in the future. The rest of the cooperative arrangements will more than likely be restricted to the role of mere contracting practices.

Industry Level to Diversify or Redirect. As a natural consequence of excess capacity in the market and even more reduced defense budgets, the ease with which the cooperative agreements necessary to achieve higher levels of weapon systems interoperability are to be reached will depend, among other factors, on the relative strength of the different forces pressing for and against international cooperation. One of the more decisive drivers will be the ability to relieve stress of the excess capacity situation by redirecting part of the aeronautical business toward other activities. The respondents do not seem to agree on this question as the dispersion of responses was high. Yet, aircraft manufacturers and assemblers earned the first place, with a secondary group of the respondents assigning these industries the third place. Major systems manufacturers and assemblers lay on the second rank, but with one third of the responses on the first rank. Finally, aircraft parts and auxiliary equipment manufacturers deserved the third position with forty percent of the responses on the first two ranks. The responses to this question could be interpreted as if

aeronautical industries were driven from the top by major firms through networks made out of relationships of interdependence, so that industries situated at lower levels in the aeronautical industry pyramid are supposed to follow their higher level companies' fate. Moreover, although auxiliary equipment manufacturers being driven out of the business is everyday event, excess capacity within the aeronautical industry as a whole is mainly conceived as an excess of final production. Under the present trends in the market toward reduced demand, unless the prime manufacturers redirect or diversify their production, a reduction of the derived production downstream in the industry would have less effect on the final product capacity as the main firm will take up the remaining business in-house without any sensible change in the international markets.

Limitations

The findings achieved in this research have been purposely kept at a low level of definition, as the first objective of this work was to identify the fields that are relevant for the problem solution and their relative order of importance. Follow-on research should be conducted afterwards within the field of parametric statistics, now that the intervening variables have been determined, to quantify the confidence intervals, the statistical tests, and models necessary to precisely define the relationships among the different variables involved in the problem.

A major limitation experienced during the research was the presence of a disturbance factor in the form of a trend to find heavier values along the principal diagonals within the matrixes of responses versus ranks. This effect would have helped reinforce the conclusions whenever the concepts were arranged in an ordinal manner. However, in the questions where the answers offered had been randomly arranged it should not be expected to see any ordered pattern. This factor could be interpreted either as lack of enough knowledge on the topic with willingness to respond (ranking first the first concept encountered, and so on), or else inherent lack of enough definition on the topic itself. Both hypotheses would benefit from follow-on research. On the other hand, this effect may limit the quantitative worthiness of the survey rankings.

Unwillingness to respond outside the official channels of command on the military side, and specially low response rates on the civilian, largely limited the number of entries per cell in the CHI-SQUARE homogeneity test, preventing the use of this test for all the subpopulations after question number five.

Conclusion

NATO is an organization composed of sixteen sovereign countries with diversity as its major characteristic deep rooted within its very origin. There are many peculiarities of the countries' partnership, where many of the members have

different levels of participation within the alliance, such as France and Spain being outside of the military integrated command structure, Denmark with restrictions for the peace-time permanent stationing of foreign forces within its territory, and Iceland and Luxembourg without national armed forces. This diversity is manifested in different perceptions of the common environment, tasks, and solutions, as showed up by the lengthy and laborious agreement process. A community of political allies but economic competitors should not be expected to easily reach high levels of agreement, and this fact arose even under the anonymity conditions of the survey mailed as part of this research.

A completely new situation is evolving quickly before the eyes of NATO planners. New environmental factors, added to the already long existing ones, will cause uncertainties in the years to come. Some of them have actually impacted NATO logistics situation, whereas others have not yet gone so far, as manifested by the survey results.

With respect to the environmental perception there was enough agreement on Perestroika and Glasnost, the European Community after 1992, increased weapon systems development costs, and conventional arms gap NATO/WP, as the major conditions driving decisions within the political, economic, and military spheres. On the other end, in spite of politicians' frequent appeals, labor force pressure was perceived as the very last environment subfactor.

The above environmental factors have already materialized in reduced defense budgets for the NATO armed forces, although it does not seem to have affected yet the situation of cross-servicing within NATO. However, if no further measures are taken it will be a matter of time to see a continuous degradation of cross-servicing capabilities as reductions in defense budgets and its consequence of diminished force strength will necessarily augment the effects of the present diversity of aircraft types on allied air forces operability. The same missions would have to be performed by less means so that the requirements for mutual operational and logistics support would increase so that higher levels of RSI would help relieving the effects of the budget reductions.

National economic interests, followed by political reasons, lies at the very heart of the causes leading to the diversity of aircraft already in service within the NATO armed forces. National Air Forces appeared as the principal responsible for this situation, although it is not up to them, but to the Departments of Defense in the first place to solve the problem. NATO exercises seems to be the main area affected by the diversity of aircraft, but followed by the areas which denote a priority of wartime logistics areas. This priority was confirmed by the preference given to armament as the logistics area which at the same time would benefit most from the solution of the problem, and most likely will help solve the problem. On the other end, shel-

ters seem to be of the least concern for NATO logisticians.

To solve the expressed problem, codevelopment is the preferred cooperative solution, followed by coproduction and family of weapons. To close the circle of solutions, the big firms of aircraft manufacturers and assemblers, from the three levels of aeronautical industries, are the ones which most likely will redirect or diversify their production to cope with the contraction of defense markets.

With all the due considerations about the details expressed in this work. it is convenient to summarize the conclusions in a paragraph as a last overview to the problem introduced in the abstract. Mainly political factors like Perestroika and Glasnost and the European Community 92 in the NATO environment have produced a situation of reduced defense budgets which has not yet translated into increased force requirements. The best solution to accomplish the same or even increased missions with less means is by sharing part of the resources necessary to build and effectively operate weapon systems through RSI, thus cross-servicing of aircraft as an essential part of RSI. The present situation of cross-servicing within the alliance is not bad, but it can and should be improved because it suffers from the impact of the diversity of aircraft types in the allied air forces. Mainly economic reasons lay behind this diversity of aircraft and the national air forces in first place are responsible for this situation, although it is not in their hands, but on the

higher defense organizations instead, to achieve the solution for this problem. To accomplish that task, armament and other Stage B cross-servicing areas present the best opportunities for cooperative work under the preferred forms of codevelopment and coproduction. Finally, the way ahead for an improved situation of cross-servicing within NATO, as a result of the reduction on the diversity of weapon systems types, will depend on the ability that the aircraft manufacturers and assemblers will develop to reduce their excess of production capacity. A new environment has evolved in such a way that it is forcing NATO planners toward cooperation with a renewed strength whose results are going to emerge during the years to come.

Apendix A: Cross-servicing of Aircraft Within NATO and the Aeronautical Industry

GENERAL BACKGROUND:

The introduction that follows has been included as a brief background for those who are not familiar with the NATO logistics concepts.

Although some aircraft in NATO are built as collaborative projects, many different national models exist and, because of their sophisticated technology, standardization work is detailed and lengthy.

One major advance is the aircraft cross-servicing system now in operation in NATO. In general terms, the system (STANAG 3430) enables aircraft of one NATO nation to be serviced at the airfields of another. Because of the different technical equipments required (specialized refuelling equipment, calibration sets etc.), the system does not allow all NATO aircraft to be serviced at all NATO airfields.

Aircraft cross-servicing falls into two categories:

STAGE A: The cross-servicing of aircraft on airfields/ships, which enables flights to be made to another, replenishment of fluids and gases, drag chutes (if applicable), starting facilities and ground handling.

STAGE B: The servicing of an aircraft on airfields/ships which enables the aircraft to be flown on an operational mission. The servicing includes all Stage A services plus the loading of weapons and/or film, including the processing and interpretation of any exposed film from the previous mission (NATO Logistics Handbook).

SECTION 1. DEMOGRAPHICS

1. Are you civilian or military?
   1 ☐ Civilian 2 ☐ Military

2. What country do you represent?
   1 ☐ Belgium 5 ☐ Germany 9 ☐ Luxembourg 13 ☐ Spain
   2 ☐ Canada 6 ☐ Greece 10 ☐ Netherlands 14 ☐ Turkey
   3 ☐ Denmark 7 ☐ Iceland 11 ☐ Norway 15 ☐ U.Kingdom
   4 ☐ France 8 ☐ Italy 12 ☐ Portugal 16 ☐ U.States

3. Which organization are you working for?
   1 ☐ National Air Forces 2 ☐ Departments of Defense
   3 ☐ NATO Cooperative Programs 4 ☐ NATO Central Bodies
   5 ☐ Aircraft Manufacturers and Assemblers 6 ☐ Engines and Engine Parts
   7 ☐ Aircraft Parts and Auxiliary Equipment
   8 ☐ Other. Please specify _____

SECTION 2. ENVIRONMENT PERCEPTION

Section Background: In this section you are requested to appraise the political, economic, and military factors affecting the general NATO environment. Next, you are requested to appraise the effects of the general environment' factors upon the NATO logistics situation.

1. **GENERAL ENVIRONMENT: Within each of the following paragraphs, please fill in the blank with the number between 1 and 5 (the'1' being the most important) that best represents the ranking of importance of the following FACTORS:**

1. Political:

1 ☐ Perestroika and Glasnost 3 ☐ Pacifism

2 ☐ Terrorism 4 ☐ INF Treaty

5 ☐ Other. Please specify: _____

2. Economic:

1 ☐ Increased Weapon System Development Costs

2 ☐ Competition on Armaments International Markets

3 ☐ Labor force pressure 4 ☐ Industry protectionism

5 ☐ Other. Please specify: _____

3. Military:

1 ☐ Conventional Arms Gap Between NATO and the Warsaw Pact

2 ☐ Insufficient level of RSI (Rationalization, Standardization and Interoperability) within NATO

3 ☐ Logistics as a national responsibility 4 ☐ Emergent Technologies

5 ☐ Other. Please specify: _____

2. Now, please fill in the blank with the number between 1 and 5 (the '1' being the most important), the TOP FIVE FACTORS among the above specified:

1. Political:	2. Economic:	3. Military:
1 ☐	1 ☐	1 ☐
2 ☐	2 ☐	2 ☐
3 ☐	3 ☐	3 ☐
4 ☐	4 ☐	4 ☐
5 ☐	5 ☐	5 ☐

3. Please check the answer which best represents the EFFECTS of the above factors upon the NATO logistics situation:

	Strongly Negative	Moderately Negative	No Effects	Moderately Positive	Strongly Positive
1. Reduced Defense Budgets	1☐	2☐	3☐	4☐	5☐
2. Increased Conventional Arms Gap NATO - Warsaw Pact	1☐	2☐	3☐	4☐	5☐
3. Increased Force Requirements	1☐	2☐	3☐	4☐	5☐
4. Other. Please specify: _____	1☐	2☐	3☐	4☐	5☐

SECTION 3. CROSS-SERVICING SITUATION

Section Background: In this section you are requested to appraise the present cross-servicing situation: and in case that you find this situation worse than neutral, you are requested to appraise the priority given to the problem's solution, and the frequency with which the cross-servicing problem affects your organization.

1. Please check the answer which best represents your appraisal of the general SITUATION of the cross-servicing of aircraft within NATO:

Excellent	Good	Fair	Neutral	NOT Satisfactory	Poor	Hopeless
1☐	2☐	3☐	4☐	5☐	6☐	7☐

2. If you found the situation worse than neutral, please check the answer which best reflects the PRIORITY given to the solution of this problem in your logistics organization:

1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐

3. Please check ONLY if you know what is the approximate NUMBER OF TIMES per year that your Air Force or other organization REQUIRES/PROVIDES cross-servicing from/to other member countries or national services

1☐ Under 10 2☐ 11-20 3☐ 21-30 4☐ 31-40 5☐ 41-50 6☐ 51-60 7☐ 70+

SECTION 4. CROSS-SERVICING PROBLEM CAUSES

Section Background: In this section you are requested to appraise the relative importance of the causes underlying the present DIVERSITY OF AIRCRAFT types within the NATO Alliance

1. Please fill in the b. with the number between 1 and 9 that best represents the rankir. importance of the following CAUSES:

   1. Political:

      1 ☐ National vs common defense 2 ☐ Differences Europe-America

      3 ☐ Other. Please specify: _____

   2. Economic:

      4 ☐ National industry protection 5 ☐ Employment protection

      6 ☐ Other. Please specify: _____

   3. Military:

      7 ☐ Armament self-sufficiency 8 ☐ Power projection

      9 ☐ Other. Please specify: _____

2. Please fill in the blank with the number between 1 and 10 which best represents the ranking of RESPONSIBILITY for the present situation of the cross-servicing of aircraft within NATO: ('1' the highest)

   1 ☐ National Air Forces 2 ☐ Departments of Defense 3 ☐ NATO Military bodies

   4 ☐ NATO civilian bodies 5 ☐ Cooperative programs 6 ☐ Aircraft Manufacturers and Assemblers

   7 ☐ Engine and Engine parts Manufacturers 8 ☐ Aircraft Parts and Auxiliary Equipment 9 ☐ Other Related Industries

   10 ☐ Other. Please specify: _____

SECTION 5. IMPACT OF CROSS-SERVICING PROBLEMS

Section Background: In this section you are requested to specify the AREAS upon which the cross-servicing deficiencies have a more decisive impact.

1. Please fill in the blank with the number between 1 and 10 (the '1' being the most important) that best represents the ranking of importance of the following areas where cross-servicing deficiencies will have the greatest impact:

1. Peacetime:

1 ☐ NATO exercises 2 ☐ Visiting country 3 ☐ Receiving country

4 ☐ Other: Please specify: _____

2. Wartime:

5 ☐ Reinforcement Plans 6 ☐ Prepositioning 7 ☐ Resupply

8 ☐ Battle Damage Repair 9 ☐ Hardened Airbase Environment

10 ☐ Other: Please specify: _____

2. Which of the following subsystems will produce the most benefits from the correction of Cross-Servicing deficiencies. Please fill in the blank with the number between 1 and 10 to rank their importance:

1 ☐ Armament 2 ☐ Replenishment 3 ☐ Emergency Supply

4 ☐ Test Equipment 5 ☐ Load Equipment 6 ☐ Personnel Training

7 ☐ Materiel Policies 8 ☐ Tech Publications 9 ☐ Shelters

10 ☐ Other. Please specify: _____

SECTION 6. CROSS-SERVICING PROBLEM SOLUTIONS

Section Background: In this section you are requested to appraise the MOST LIKELY SOLUTIONS for the cross-servicing problem.

1. Please fill in the blank with the number between 1 and 10 (the '1' being the highest) ranking those subsystems which best represent the opportunity for IMPROVED Standardization and Interoperability)

1 ☐ Armament
2 ☐ Replenishment
3 ☐ Emergency Supply
4 ☐ Test Equipment
5 ☐ Load Equipment
6 ☐ Personnel Training
7 ☐ Materiel Policies
8 ☐ Tech Publications
9 ☐ Shelters
10 ☐ Other. Please specify: _____

2. Ranking between 1 and 10 the importance of the ROLE that the following organizations have to play to SOLVE the cross-servicing problem:

1 ☐ National Air Forces
2 ☐ Departments of Defense
3 ☐ NATO Military Bodies
4 ☐ NATO Civilian Bodies
5 ☐ Cooperative Programs
6 ☐ Airframe Assemblers
7 ☐ Major Systems Manufacturers and Assemblers
8 ☐ Aircraft Parts and Auxiliary Equipment
9 ☐ Other Related Industries
10 ☐ Other. Please specify: _____

3. Ranking between 1 and 7 the type of COOPERATIVE PROGRAMS that most likely will help to solve the problem of diversity of weapon systems within the NATO Alliance:

1 ☐ Codevelopment
2 ☐ License Production
3 ☐ Coproduction
4 ☐ Packages
5 ☐ Family of Weapons
6 ☐ Opening Defense Markets
7 ☐ Other. Please specify: _____

4. Ranking between 1 and 4 the level of AERONAUTICAL INDUSTRY which most likely has to DIVERSIFY OR REDIRECT its production, to cope with the contraction of defense markets:

1 ☐ Aircraft Manufacturers and Assemblers
2 ☐ Major System Manufacturers and Assemblers
3 ☐ Aircraft Parts and Auxiliary Equipment
4 ☐ Other. Please specify: _____

SECTION 7. COMMENTS

1. Please list any other concern that you have which may not have been covered in the questionnaire.

1. _____
_____
_____

2. _____
_____
_____

3. _____
_____
_____

4. _____
_____
_____

5. _____
_____
_____

If you would like a Summary Report of this study, simply check the box. A copy will be sent as soon as possible after completion of the survey.

YES ☐ NO ☐

If you checked YES, please include your address:

Name: _____

Address: _____

_____

City: _____ Code: _____

Country: _____

THANK YOU VERY MUCH again for your cooperation in this study.

Appendix B: List of Graphics Showing Cross-Servicing of Aircraft Survey Results

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TABLE 1

CROSS-SERVICING OF AIRCRAFT SURVEY

SUMMARY REPORT

ENVIRONMENT:	PACTORS													
	INDEPENDENT							TOP FIVE						
	1	2	3	4	5	MEDIAN	MODE	1	2	3	4	5	MEDIAN	MODE
POLITICAL:														
Perestroika	29	16	5	2	0	1	1	14	3	1	1	0	1	1
Terrorism	2	9	12	14	11	4	4	0	3	1	2	0	2	2
Pacifism	6	12	11	17	2	3	4	2	0	1	0	2	3	BI
INF Treaty	9	11	15	11	1	3	3	0	0	4	5	5	4	0
Other Political	5	3	2	4	9	4	5	0	0	0	0	4	5	5
ECONOMIC:														
Incr.W/S Dev.Costs	27	18	3	3	1	1	1	7	4	3	1	1	2	1
Competition	9	19	17	3	3	2	2	0	6	1	3	2	2	2
Jobs	0	4	12	29	5	4	4	0	0	2	1	0	3	3
Industry Protection	6	12	20	11	2	3	3	2	2	1	0	3	2	5
Other Economic	8	2	1	1	12	5	5	0	1	0	2	4	5	5
MILITARY:														
Conventional Gap	20	15	9	5	2	2	1	1	5	3	1	0	2	2
Insufficient RSI	18	14	13	5	0	2	1	1	4	3	4	1	3	BI
Log.National Resp.	6	14	18	10	4	3	3	0	0	5	2	1	3	3
Emergent Tech.	3	9	10	25	3	4	4	1	0	2	1	1	3	3
Other Military	4	1	1	1	12	5	5	0	0	1	0	0	3	3

AVG: Average
MED: Median
MOD: Mode
STD: Standard Deviation

TABLE 2: ENVIRONMENT PERCEPTION: OTHER RESPONSES

		NUMBER	RANKS
POLITICAL	Different opinions between the NATO nations	1	2
	European Community '92	4	1
	Growing US Defense orientation toward 3rd World conflict (and Responsiveness vs. Sustainability)	1	2
	Increasing unwillingness to pay for defense outside USA	1	4
	LSBM & CFE Vienna; MBFR.	2	1
	National Policies	2	5
	Other operational priorities	1	4
	Political and local conditioning	1	5
	Socio-economic welfare	1	1
	Situation in USSR satellite countries	1	1
	Willingness of people to stay free	1	1
ECONOMIC	Budget cuts by various nations	2	2
	Butter vs. guns	1	1
	Coordination Effort to Generally expand NATO (European economic impact worldwide)	1	1
	Industry changing business to other than military	1	5
	Insufficient Investments	1	5
	Lack of adequate resources	1	2
	National economic policy	2	1
	Socio-economic welfare	1	1
	Soviet economic situation	1	1
MILITARY	IEPG threat perception	1	1
	Military-industrial interelations (mutually supporting)	1	1
	Military local policy	2	2
	Modernization of Weapons on Time	1	4
	Political context	2	1
	Reduction of forces	1	5
	Restrictions on live training	1	3

TABLE 3: EFFECTS OF ENVIRONMENT FACTORS UPON NATO LOGISTICS SITUATION

	Strong Neg 1	Mod Neg 2	No Eff 3	Mod Pos 4	Strong Pos 5	AVG	STD	MODE
1. REDUCED DEFENSE BUDGETS	20	28	0	1	0	1.6	0.6	2
2. INCREASED CONVENTIONAL ARMS GAP NATO-WARSAW PACT	8	17	8	14	2	2.7	1.2	2
3. INCR. FORCE REQUIREMENTS	3	19	12	12	2	2.8	1	2
4. OTHER	3	3	0	0	1	2	1.4	BI

OTHER RESPONSES

	NUMBER	RANKS
Priorities in Europe	1	2
Limitation on NATO exercises	1	1
Investment in Weapon Systems vs. Ammunition	1	1
Not enough Transportation System	1	2

TABLE 4: CROSS-SERVICING SITUATION

* SITUATION *	Excel 1	Good 2	Fair 3	Neutr 4	NOT Satis 5	Poor 6	Hopeless 7
1. CROSS-SERVICING SITUATION	0	9	18	9	12	4	0
2. PRIORITY TO SOLUTION	0	2	2	5	3	2	0
3. FREQUENCY OF UTILIZATION	1	1	1	0	0	1	9
	<10						>70

	AVG	STD	MODE
1. CROSS-SERVICING SITUATION	3.69	1.22	3
2. PRIORITY TO SOLUTION	4.07	1.22	4
3. FREQUENCY OF UTILIZATION	5.08	2.12	7

TABLE 5: CROSS-SERVICING PROBLEM CAUSES

* CAUSES *	RANKS 1	2	3	4	5	6	7	8	9	MEDIAN	MODE
POLITICAL											
National vs common defense	12	9	8	7	3	2	2	0	1	3	1
Differences Europe-America	8	11	5	5	8	9	1	1	1	4	2
Other	0	0	3	2	1	2	4	0	2	6	7
ECONOMIC											
Nat. industry protectionism	31	9	7	2	0	0	1	0	1	1	1
Employment protection	2	10	7	5	12	5	0	0	1	4	5
Other	2	2	3	1	1	1	3	4	0	5	8
MILITARY											
Armament self-sufficiency	2	7	12	11	3	5	1	3	1	4	3
Power projection	0	2	1	6	12	14	2	2	3	5	6
Other	2	1	1	1	1	1	2	4	5	8	9

OTHER RESPONSES

	NUMBER	RANKS
POLITICAL		
Country's particularities	1	3
Different evaluation of the threat	1	7
Dispute between nations	1	9
National Industry protection	1	1
National interests	1	4
Political identity	1	5
The US will provide protection	1	6
ECONOMIC		
Cost of spare parts	1	7
Industrial deficiency	1	6
Insufficient joint venture production programs	1	5
Low budgets	1	3
Nations desire to keep track in high tech.	1	3
Overheads subcontractors (A-costs)	1	1
Protective technology exchange practice by US	1	1
Social and economic welfare systems	1	2
MILITARY		
Ammunition/Aircraft interoperability	1	4
Defense budgets	1	3
Different operational programs	1	6
Diversity of tasks and missions	1	1
General officer whim	1	5
Lack of common requirements, vision, and budget	1	1
Military and industry work together with governments to exclude competition	1	8
Personnel problems	1	9
Special defense requirements	1	8

TABLE 6: CROSS-SERVICING PROBLEM RESPONSIBILITY AND IMPACT

RESPONSIBILITY	RANKS 1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
National Air Forces	18	9	7	8	2	2	1	2	2	1	2	1
Departments of Defense	13	18	7	3	4	3	1	1	0	0	2	2
NATO Military Bodies	10	10	13	5	3	3	2	3	0	2	3	3
Nato Civilian Bodies	2	3	4	8	8	5	8	7	3	0	5	TRI
Cooperative Programs	1	4	6	8	9	2	7	6	5	0	5	5
Manufacturers & Assemblers	3	3	3	7	11	16	1	2	0	0	5	6
Engine and Engine Parts	0	2	3	5	8	11	14	3	1	0	6	7
Parts & Auxiliary Equipment	0	2	6	2	3	6	9	16	1	1	7	8
Other Related Industries	0	0	2	2	1	2	3	4	27	2	9	9
Other	4	1	1	1	0	0	0	0	1	10	10	10

OTHER RESPONSES	NUMBER	RANKS
Individual European Vice-NATO civilian bodies	1	1
Mat. Govs. support for protectionism & subsidies	3	1 2
National programs	1	4
Suppliers	1	10
Well trained and experienced maintenance team	1	10

IMPACT	RANKS 1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
PEACETIME												
NATO Exercises	21	2	1	2	5	6	4	3	1	0	2	1
Visiting Country	6	12	2	4	4	0	11	6	1	1	4	2
Receiving Country	1	5	11	0	4	6	0	12	5	0	6	8
Other	0	1	0	2	0	1	1	0	1	4	8	10
WARTIME												
Reinforcement Plans	7	12	11	9	3	3	1	2	0	0	3	2
Prepositioning	8	11	6	8	8	3	1	2	0	0	3	2
Resupply	6	9	9	8	4	4	3	2	0	0	3	BI
Battle Damage Repair	6	6	7	3	9	4	6	2	1	0	4	5
HAE	1	0	4	6	9	7	6	4	6	1	6	5
Other	5	2	0	0	0	2	0	0	3	3	6	1

OTHER RESPONSES	NUMBER	RANKS
Crew training	1	4
Effectiveness in fighting	1	1
Exchange of technology	1	2
Flight lines	1	9
Forces flexibility	3	1 2
NATO Airpower	1	1
Reconstruction	1	10
Responsiveness and Sustainability	1	1
Starting facilities and ground handling	1	10

TABLE 7: CROSS-SERVICING PROBLEM BENEFITS AND OPPORTUNITY

* BENEFITS *	RANKS 1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
Armament	18	10	6	6	3	3	0	2	1	0	2	1
Replenishment	10	18	7	2	4	4	0	2	1	0	2	2
Emergency Supply	6	5	13	2	6	5	5	4	1	0	3	3
Test Equipment	1	5	6	13	6	8	7	1	1	0	4	4
Load equipment	1	7	8	5	6	8	8	1	0	0	5	TRI
Personnel Training	5	4	5	11	11	6	5	1	0	0	4	BI
Materiel Policies	4	2	4	2	3	1	9	16	3	1	7	8
Tech Publications	1	1	3	5	6	6	5	9	9	1	7	BI
Shelters	0	0	0	0	1	5	4	8	24	3	9	9
Other	5	0	1	0	0	0	0	0	0	6	7	10

OTHER RESPONSES

	NUMBER	RANKS
Film processing and interpreting	1	10
Mission capabilities	1	1
NATO's credibility in deployment of external reinforcements	1	1
Software support	1	1
Suppliers	1	10
Weapon load equipment	1	1

* OPPORTUNITY *	RANKS 1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
Armament	20	3	4	5	3	7	3	2	2	0	3	1
Replenishment	8	9	6	2	2	4	7	5	4	0	4	2
Emergency Supply	4	5	5	7	6	9	2	6	1	1	5	6
Test Equipment	3	7	8	7	10	5	3	3	1	0	4	5
Load equipment	0	12	7	7	8	1	8	3	1	0	4	2
Personnel Training	4	4	12	6	6	5	6	5	0	0	4	3
Materiel Policies	5	7	2	4	3	8	7	8	2	0	6	BI
Tech Publications	3	2	7	8	6	5	5	5	4	0	5	4
Shelters	0	1	0	1	1	1	3	8	23	3	9	9
Other	5	1	0	0	0	0	0	0	0	6	6	10

OTHER RESPONSES

	NUMBER	RANKS
Aircraft types	2	1 2
Convince European Governments	1	1
Facilities on procurement of armaments	1	1
Software support	1	1
Suppliers	1	10

TABLE 8: CROSS-SERVICING PROBLEM ROLE AND COOPERATIVE PROGRAMS

* ROLE *	RANKS 1	2	3	4	5	6	7	8	9	10	MEDIAN	MODE
National Air Forces	10	7	16	10	2	0	0	3	2	1	3	3
Departments of Defense	19	13	10	3	2	1	0	2	0	0	2	1
NATO Military Bodies	17	14	7	3	3	3	1	0	1	1	2	1
Nato Civilian Bodies	1	8	8	11	7	3	5	1	4	1	4	4
Cooperative Programs	1	3	6	15	13	2	4	3	1	0	4	4
Manufacturers & Assemblers	1	0	1	2	7	19	10	6	1	0	6	6
Engine and Engine Parts	1	2	1	3	8	11	17	5	0	0	6	7
Parts & Auxiliary Equipment	1	1	1	1	6	6	7	20	3	0	7	8
Other Related Industries	0	0	1	1	1	3	2	7	28	1	9	9
Other	2	1	0	1	0	0	0	0	0	9	10	10

OTHER RESPONSES	NUMBER	RANKS
Industrial policy	1	4
National Governments	2	1 2
Suppliers	1	10

* COOPERATIVE PROGRAMS *	RANKS 1	2	3	4	5	6	7	MEDIAN	MODE
Codevelopment	32	10	2	4	2	0	0	1	1
License Production	4	5	13	12	14	3	0	4	5
Coproduction	8	22	17	1	1	1	0	2	2
Packages	0	0	1	10	15	19	0	5	6
Family of Weapons	7	8	11	12	7	2	1	3	4
Opening Defense Markets	1	5	4	9	8	18	2	5	6
Other	1	0	1	0	0	1	7	7	7

OTHER RESPONSES	NUMBER	RANKS
Changing attitude of US Government and Industry	1	1
Co-Follow on support	1	7
Political willingness	1	1
Sub-contracts	1	7

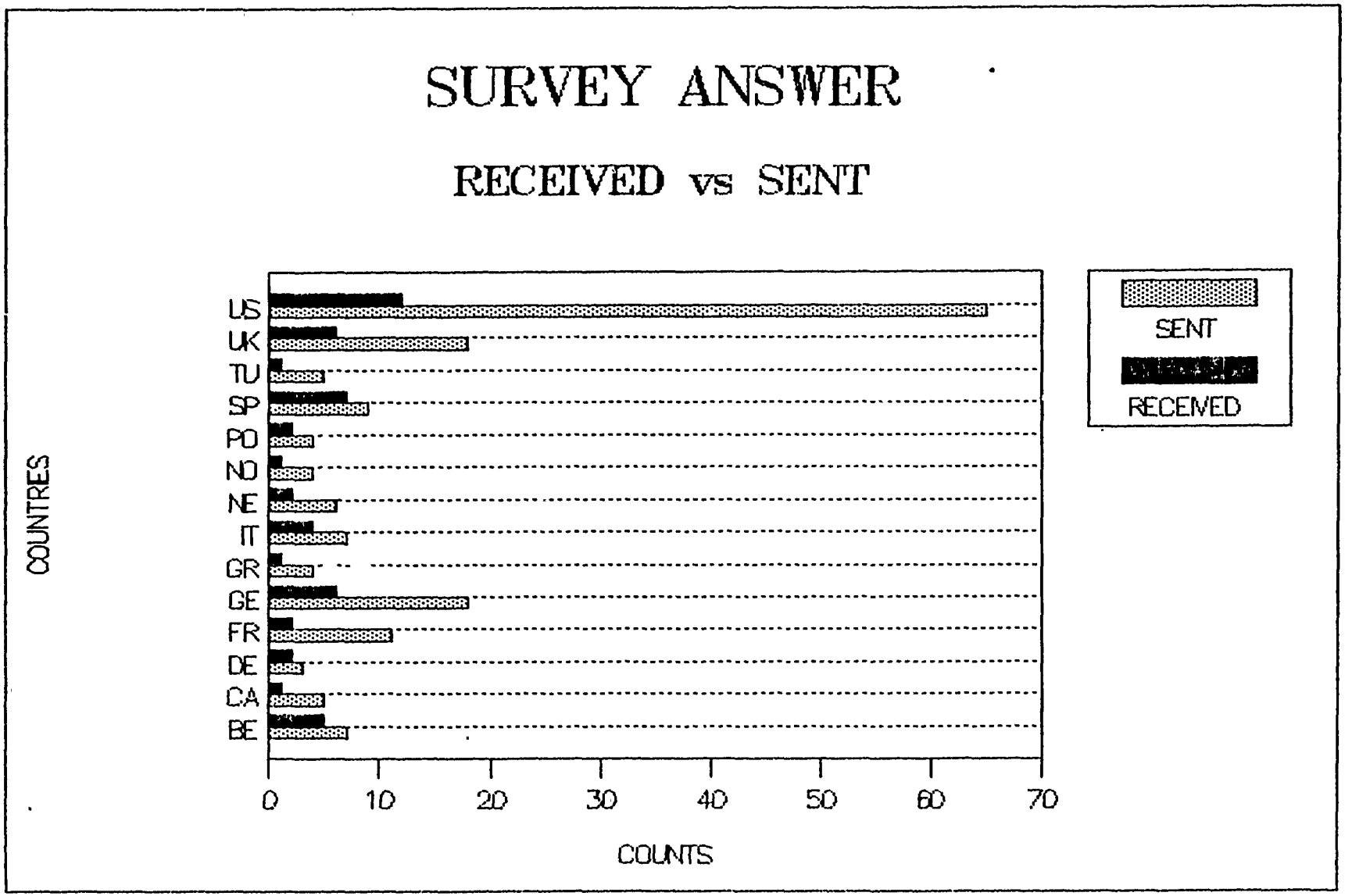
TABLE 9: INDUSTRY TO DIVERSIFY AND GENERAL COMMENTS

INDUSTRY TO DIVERSIFY	RANKS 1	2	3	4	MEDIAN	MODE
A/C Manufacturers	29	6	15	1	1	1
Major Systems Manufacturers	13	31	5	0	2	2
A/C Parts and Auxiliary Equipment	8	12	29	0	3	3
Other	1	0	0	9	4	4

OTHER RESPONSES	NUMBER	RANKS
Diversity of manufacturers	1	4
Research activity of manufacturers	1	1

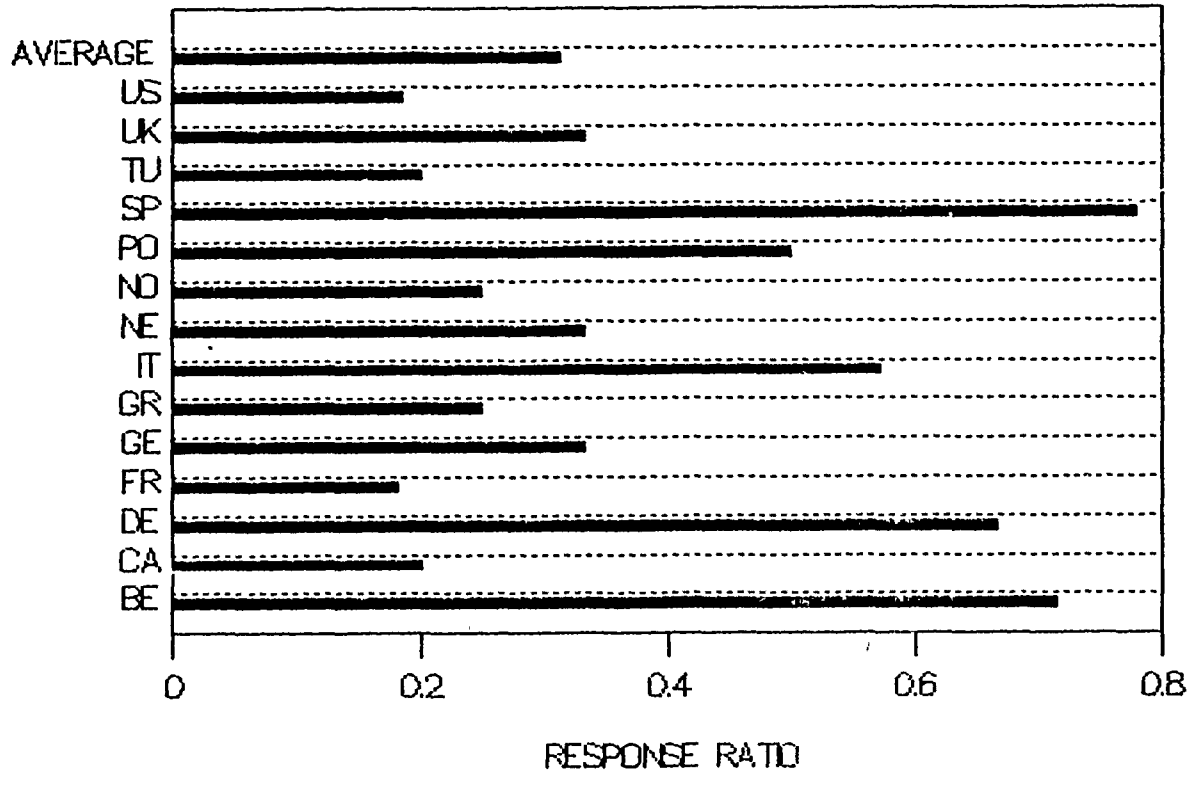
COMMENTS

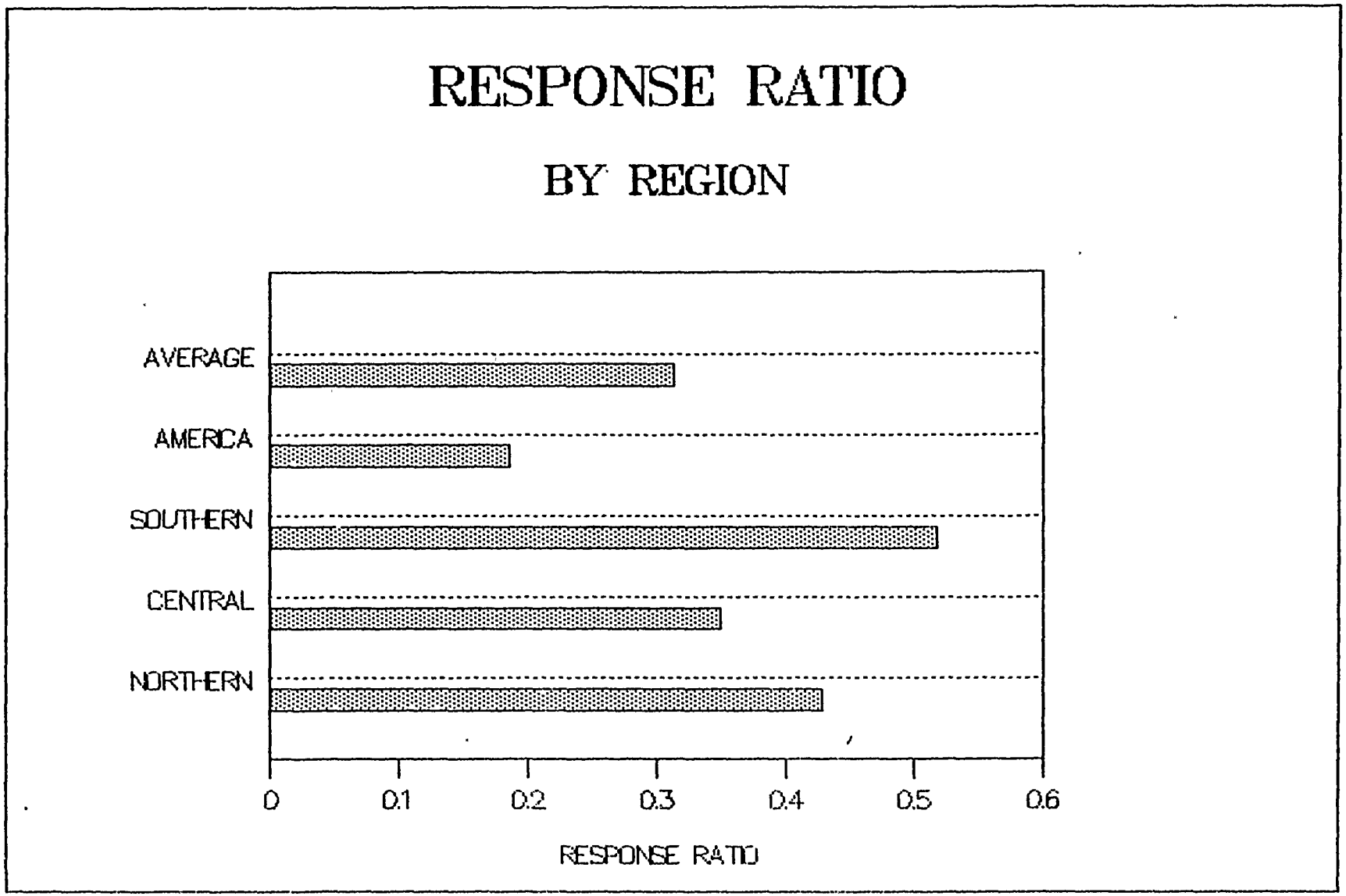
1. The first problem in the area of Aircraft Cross-Servicing is Standardization (the establishment of STANAGS), and more important the honoring of these STANAGS by all NATO countries.
2. Another problem is the Interoperability as well for weapon systems as for Missions flown for all deployment air bases (AMMO-Fuel and Stage A material).
3. Apart from aircraft and weapons interoperability, cross-sevicing also involves personnel, trainning and procurement of test equip To acquire sufficent personnel and test equipment is becoming more difficult.
4. Cross-Servicing has to be role oriented as a function of preestablished deployment/redeployment plans. Role meaning FBA or AWI or RECCE, etc.
5. Cross-Servicing of transportation aircraft should be looked at as well (actual x-s plans only speak about fighter aircraft).
6. Software support for mission support systems and aircraft subsystems

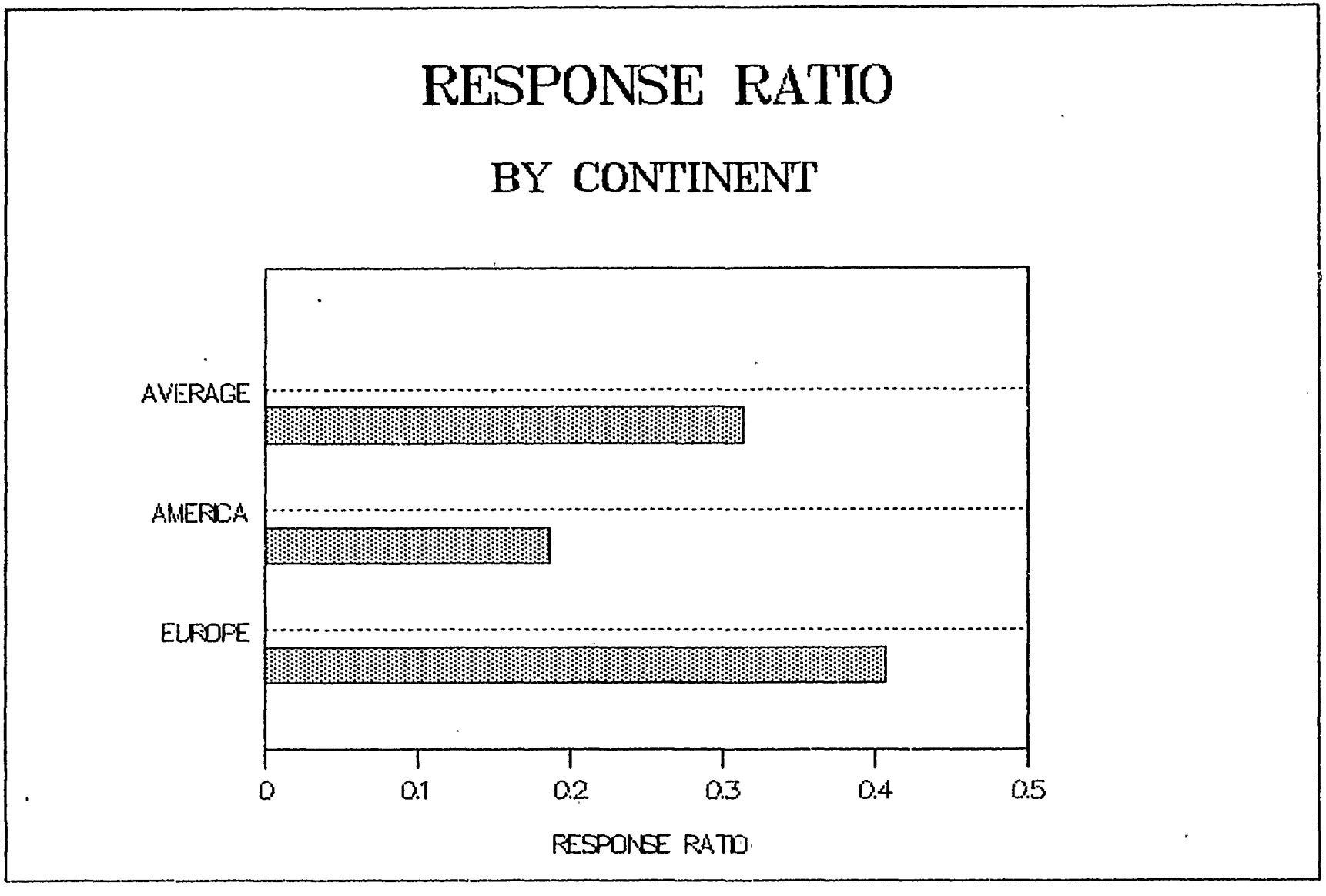

SURVEY ANSWER
RECEIVED vs SENT
COUNTRES
US
UK
TU
SP
PO
NO
NE
IT
GR
GE
FR
DE
CA
BE
0
10
20
30
40
50
60
70
COUNTS
SENT
RECEIVED

RESPONSE RATIO

BY COUNTRY

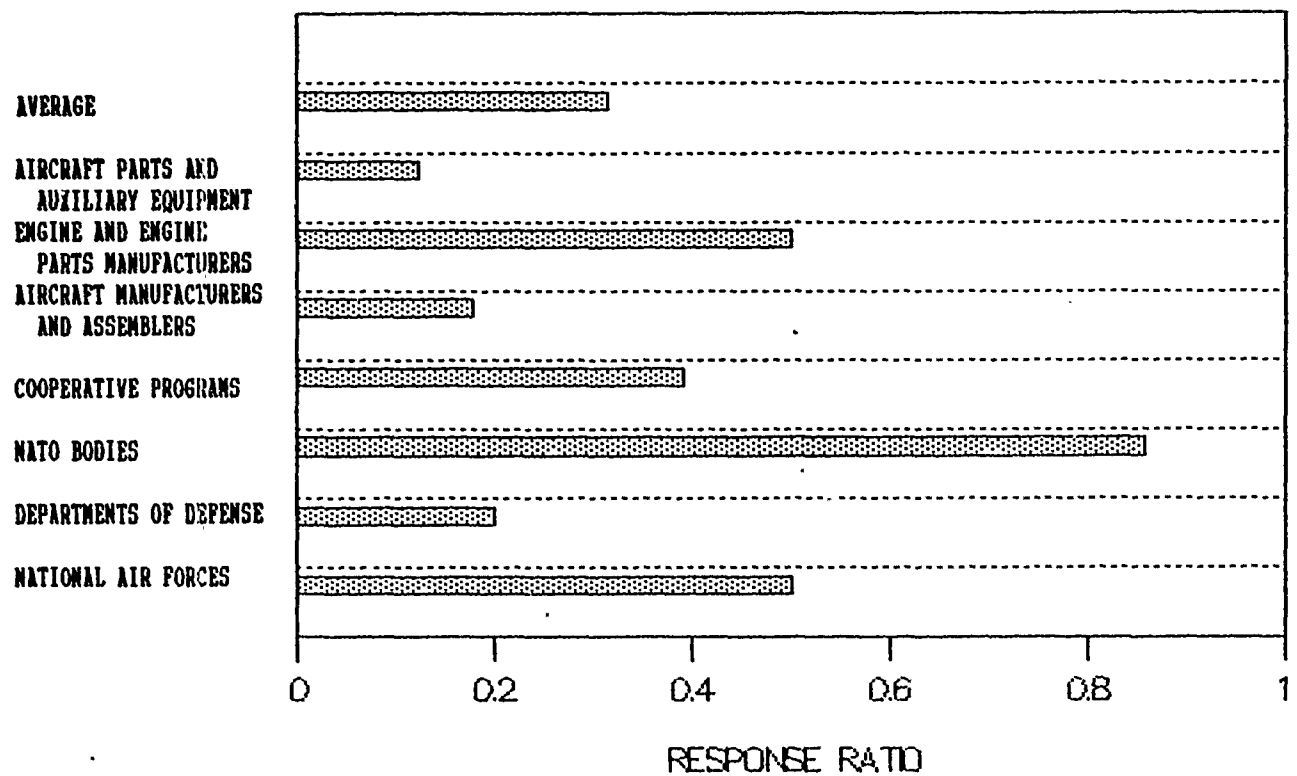


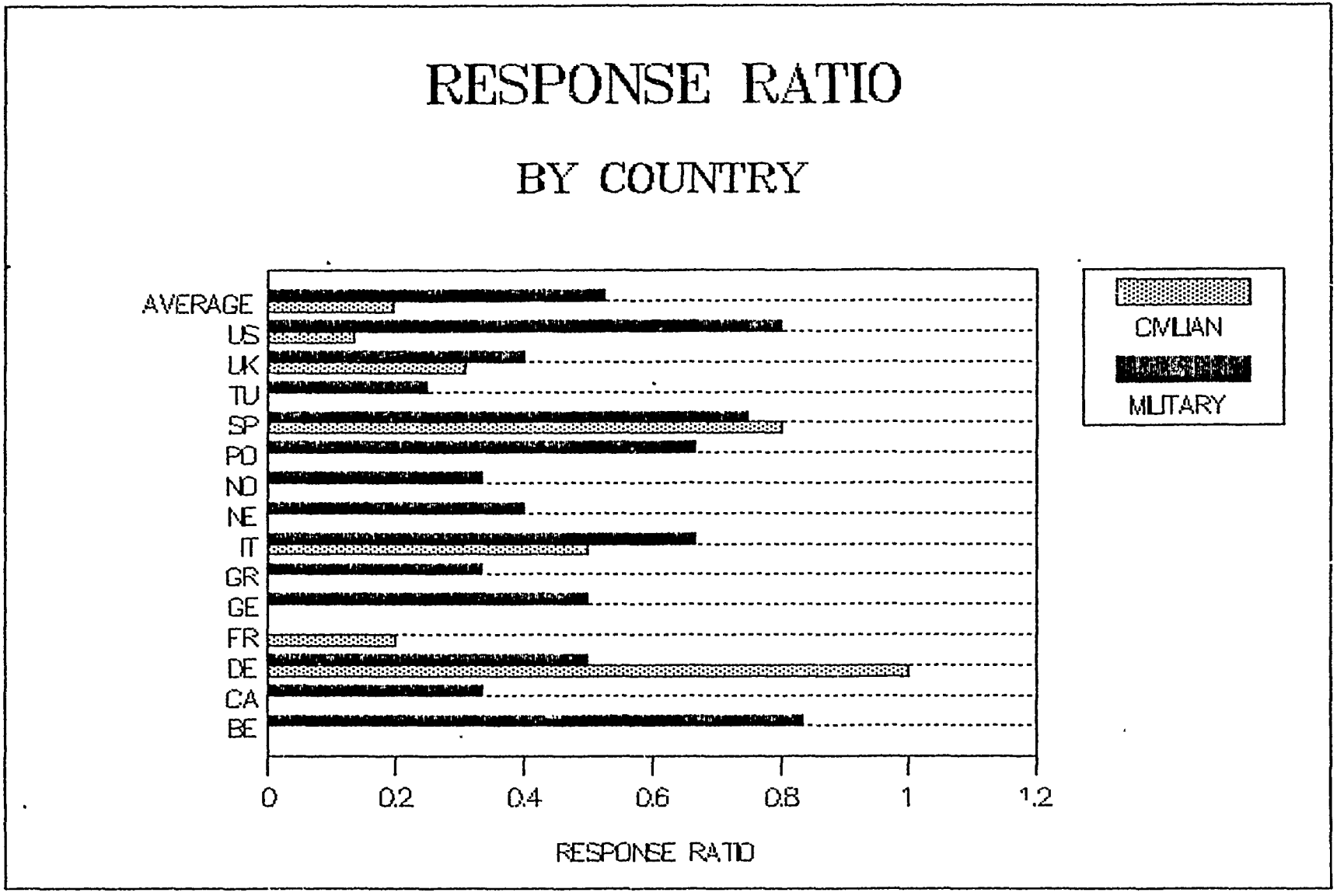

RESPONSE RATIO
BY REGION
AVERAGE
AMERICA
SOUTHERN
CENTRAL
NORTHERN
0
0.1
0.2
0.3
0.4
0.5
0.6
RESPONSE RATIO

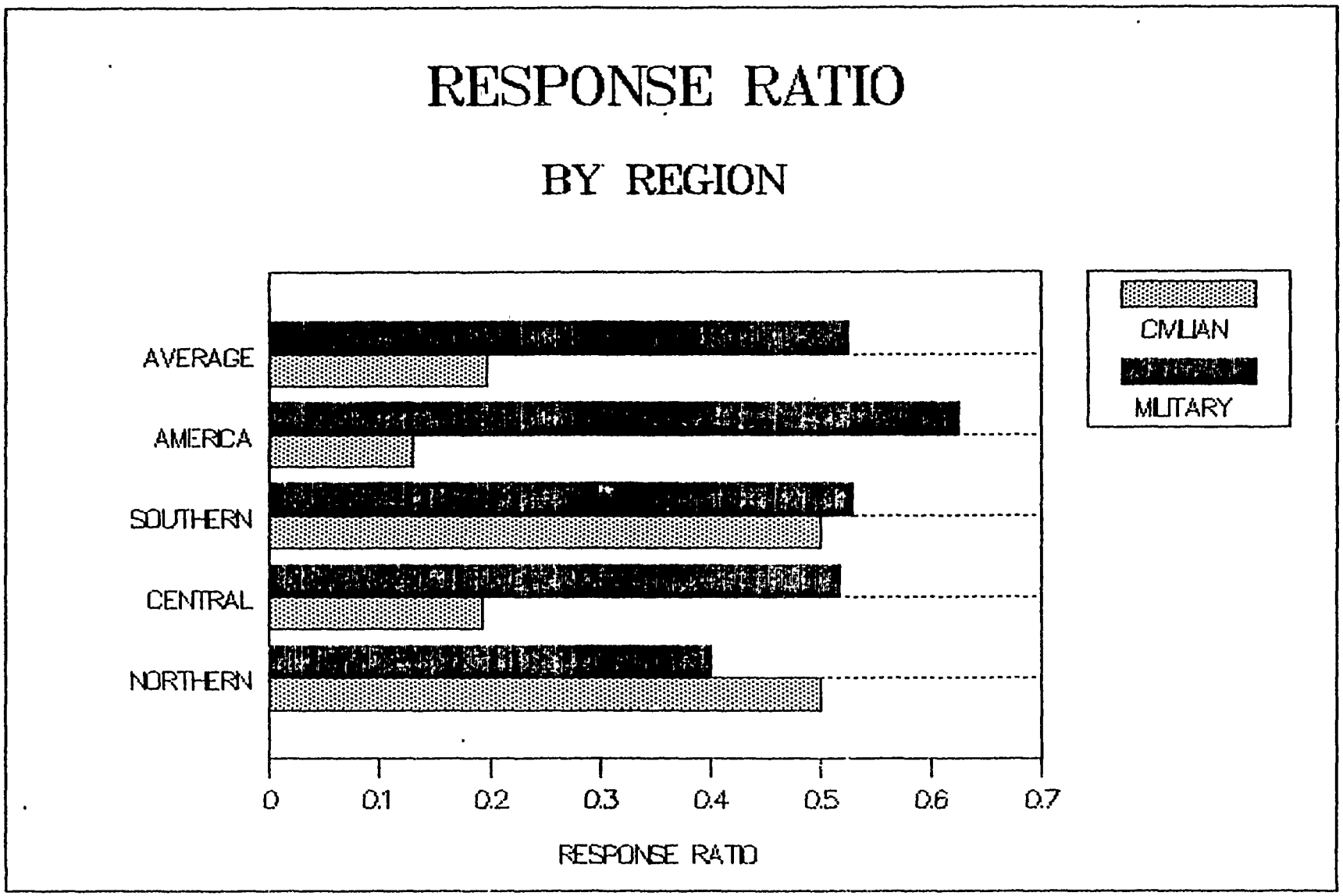

RESPONSE RATIO
BY CONTINENT
AVERAGE
AMERICA
EUROPE
0
0.1
0.2
0.3
0.4
0.5
RESPONSE RATIO

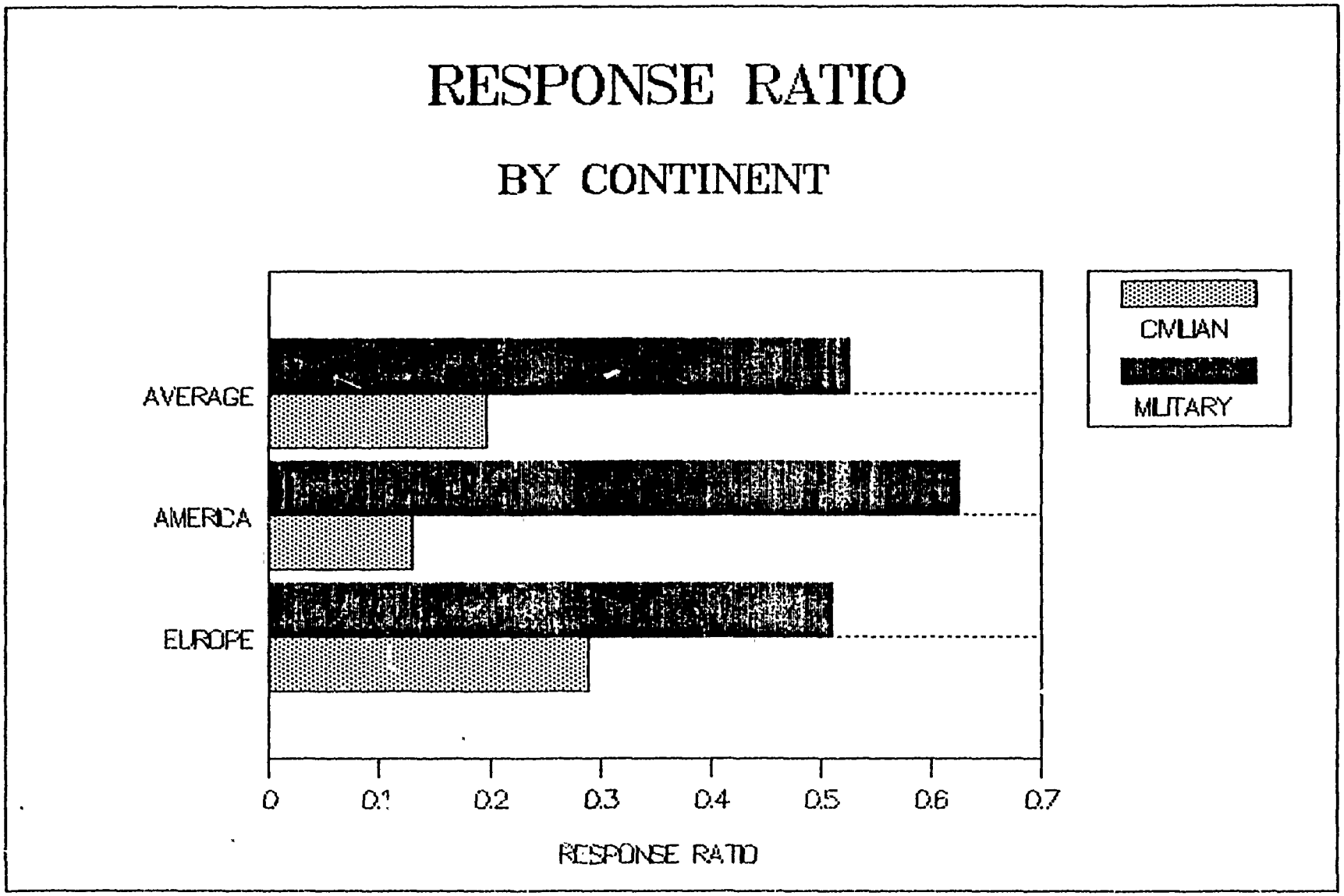
RESPONSE RATIO

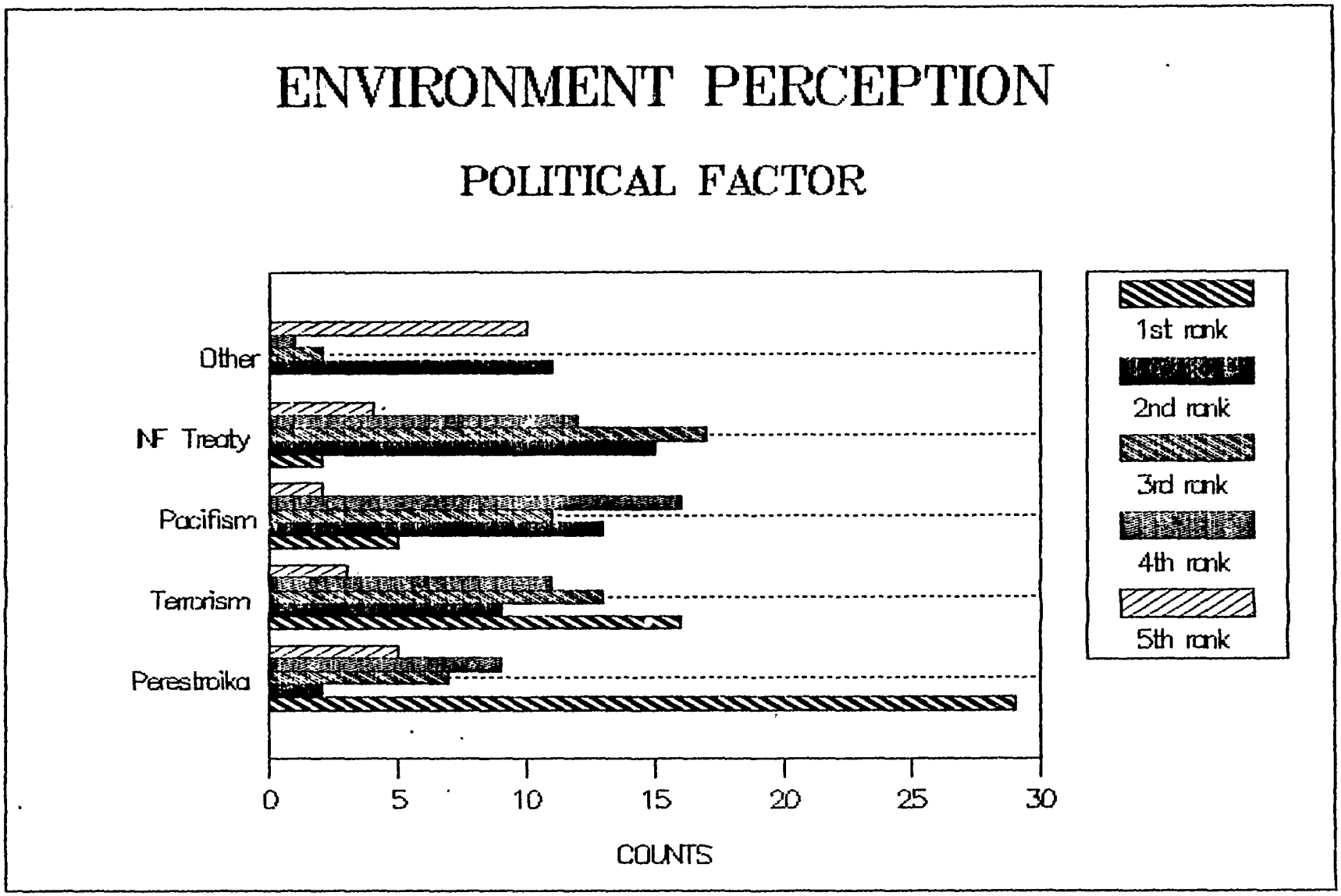
BY ORGANIZATION

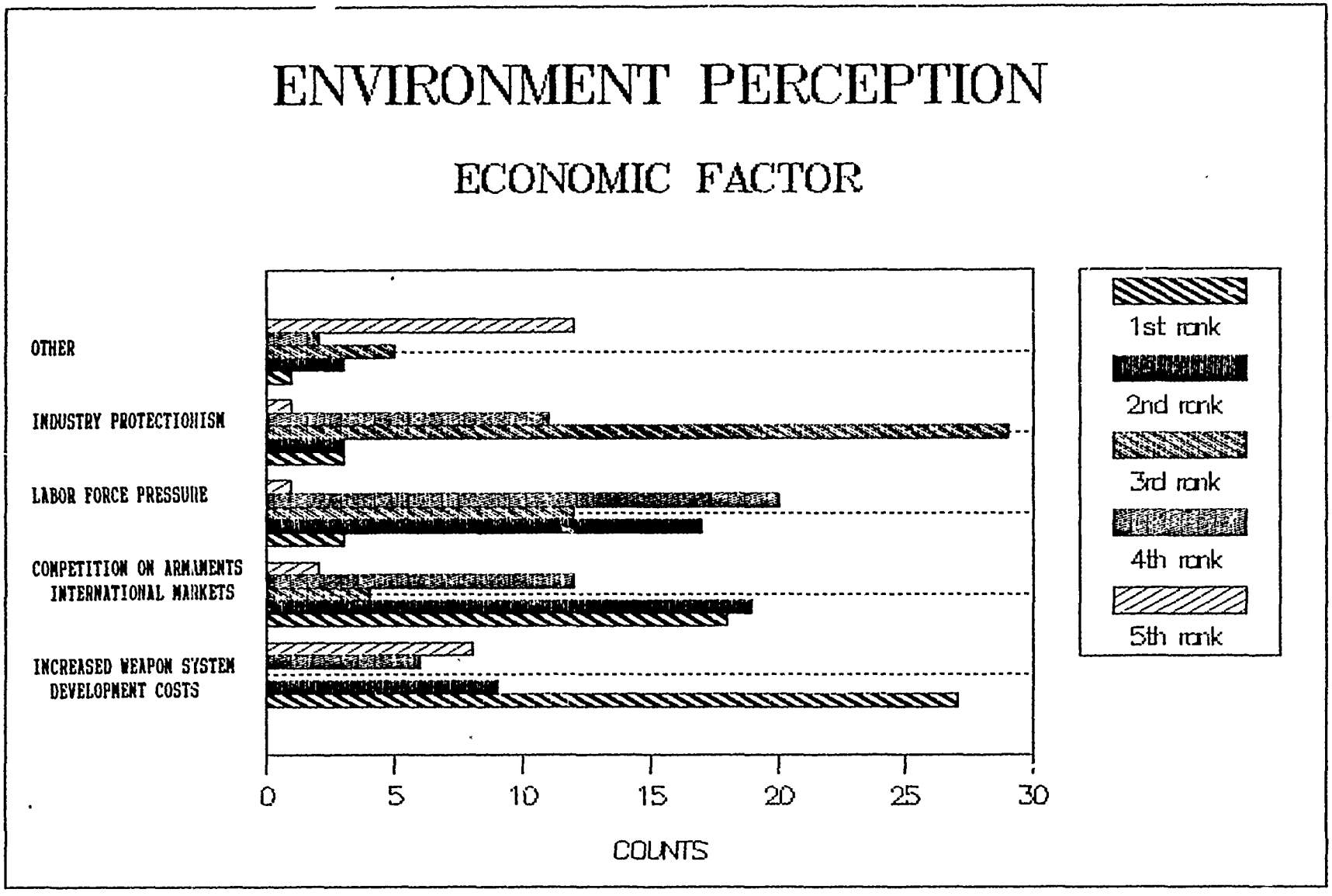


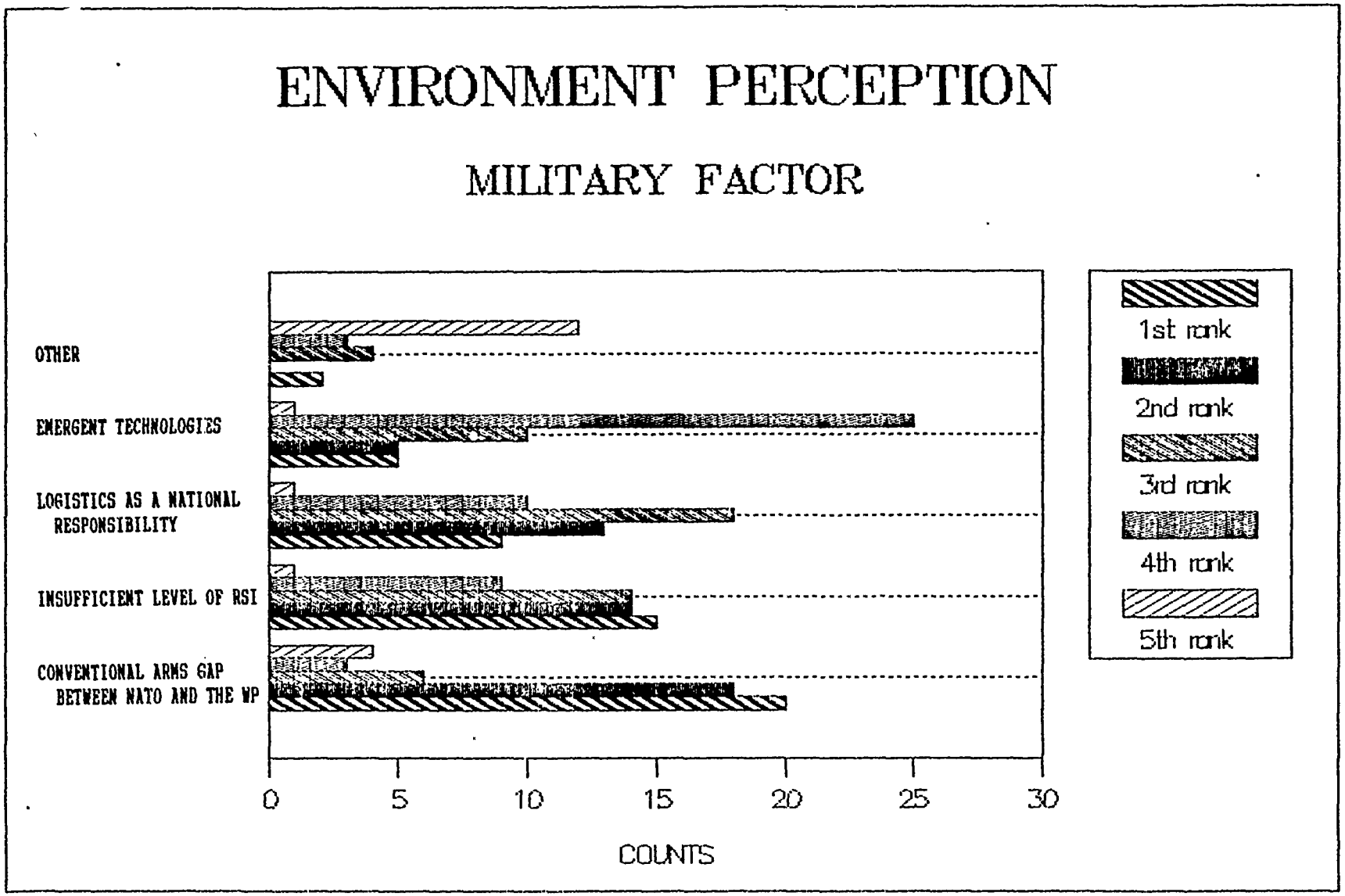

RESPONSE RATIO
BY COUNTRY
AVERAGE
US
UK
TU
SP
PO
ND
NE
IT
GR
GE
FR
DE
CA
BE
0
0.2
0.4
0.6
0.8
1
1.2
RESPONSE RATIO
CIVILIAN
MILITARY


RESPONSE RATIO
BY REGION
AVERAGE
AMERICA
SOUTHERN
CENTRAL
NORTHERN
CIVLIAN
MILITARY
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
RESPONSE RATIO


RESPONSE RATIO
BY CONTINENT
AVERAGE
AMERICA
EUROPE
CIVILIAN
MILITARY
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
RESPONSE RATIO

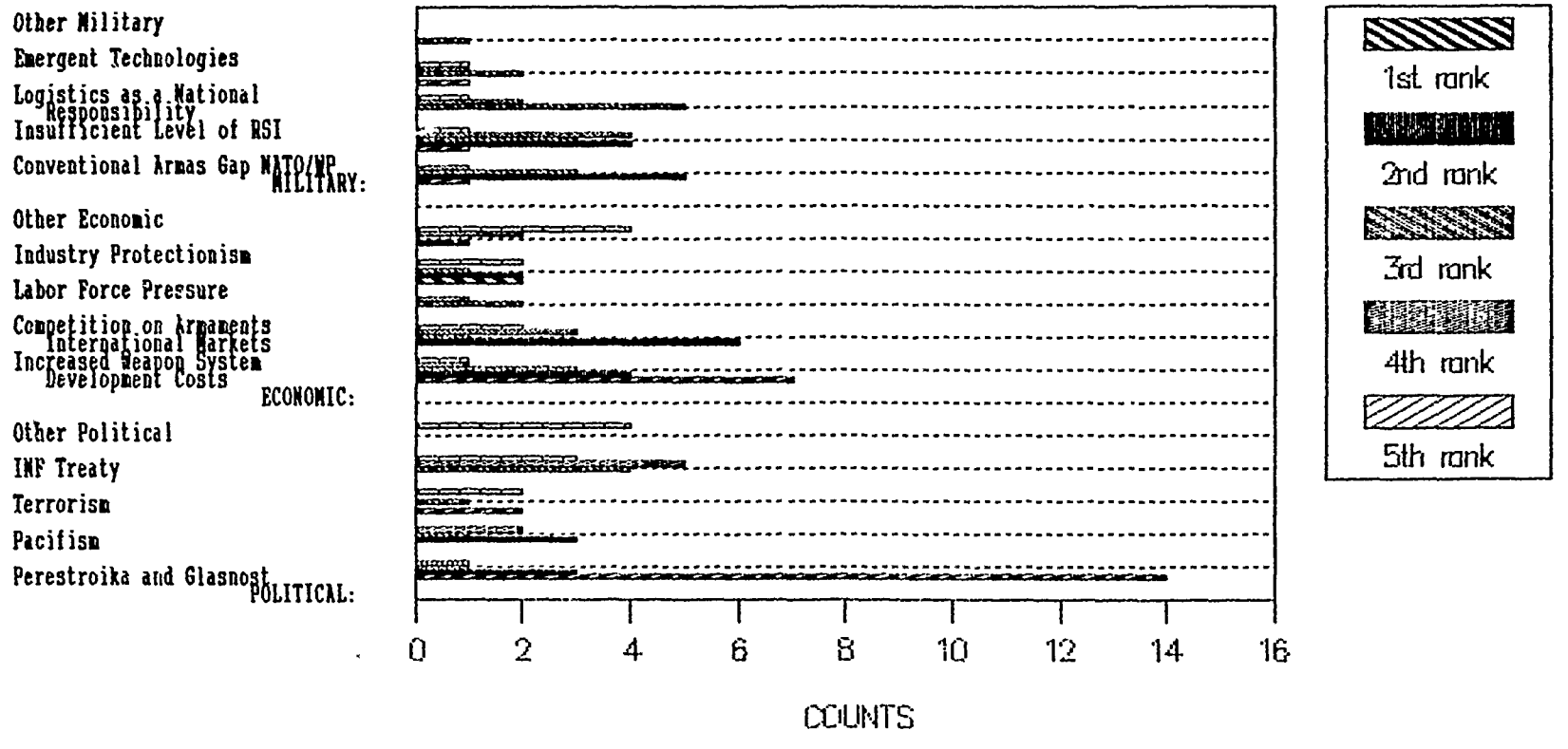

ENVIRONMENT PERCEPTION
POLITICAL FACTOR
Other
INF Treaty
Pacifism
Terrorism
Perestroika
0
5
10
15
20
25
30
COUNTS
1st rank
2nd rank
3rd rank
4th rank
5th rank


ENVIRONMENT PERCEPTION
ECONOMIC FACTOR
OTHER
INDUSTRY PROTECTIONISM
LABOR FORCE PRESSURE
COMPETITION ON ARMAMENTS
INTERNATIONAL MARKETS
INCREASED WEAPON SYSTEM
DEVELOPMENT COSTS
0
5
10
15
20
25
30
COUNTS
1st rank
2nd rank
3rd rank
4th rank
5th rank


ENVIRONMENT PERCEPTION
MILITARY FACTOR
OTHER
EMERGENT TECHNOLOGIES
LOGISTICS AS A NATIONAL RESPONSIBILITY
INSUFFICIENT LEVEL OF RSI
CONVENTIONAL ARMS GAP BETWEEN NATO AND THE WP
0
5
10
15
20
25
30
COUNTS
1st rank
2nd rank
3rd rank
4th rank
5th rank

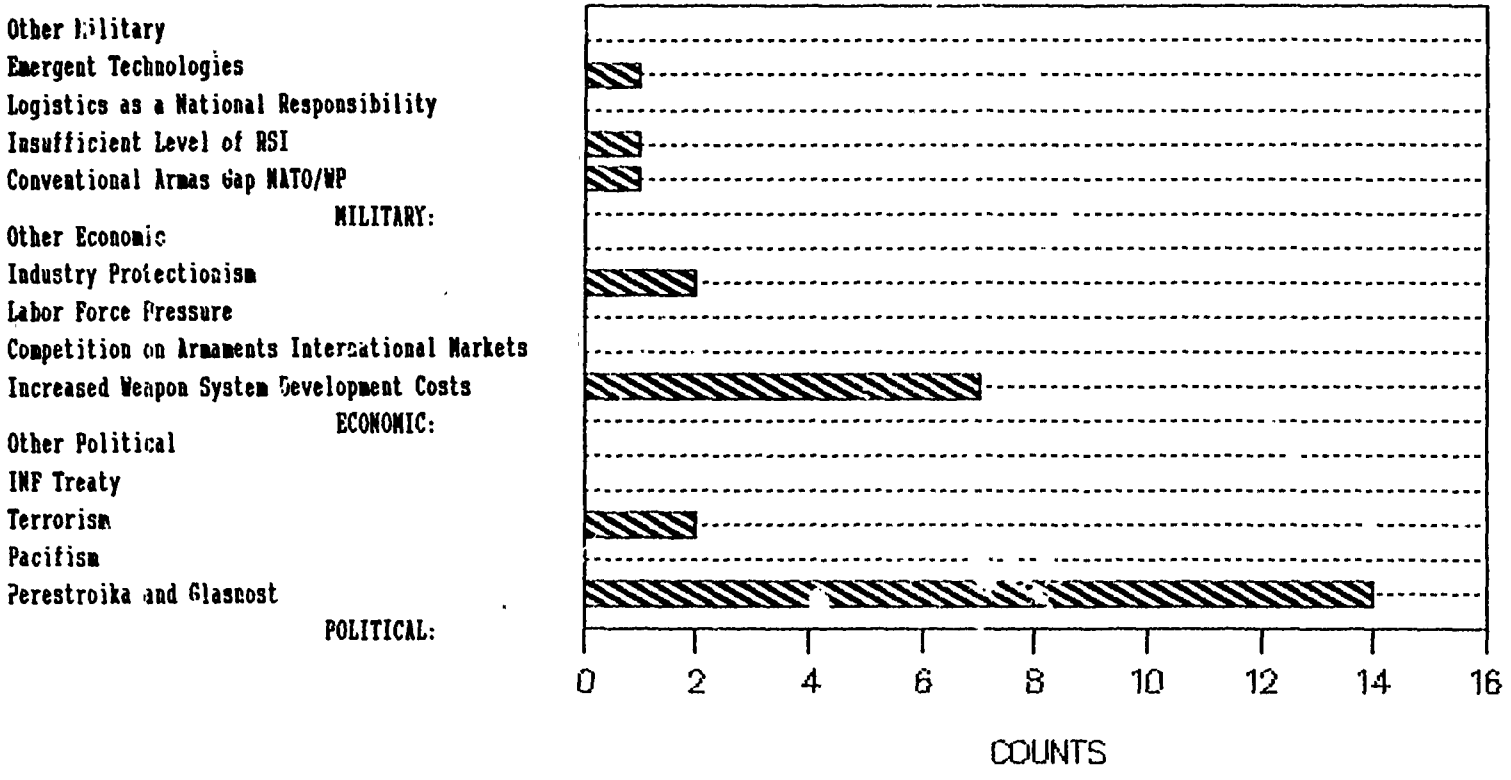
ENVIRONMENT PERCEPTION

TOP FIVE FACTORS



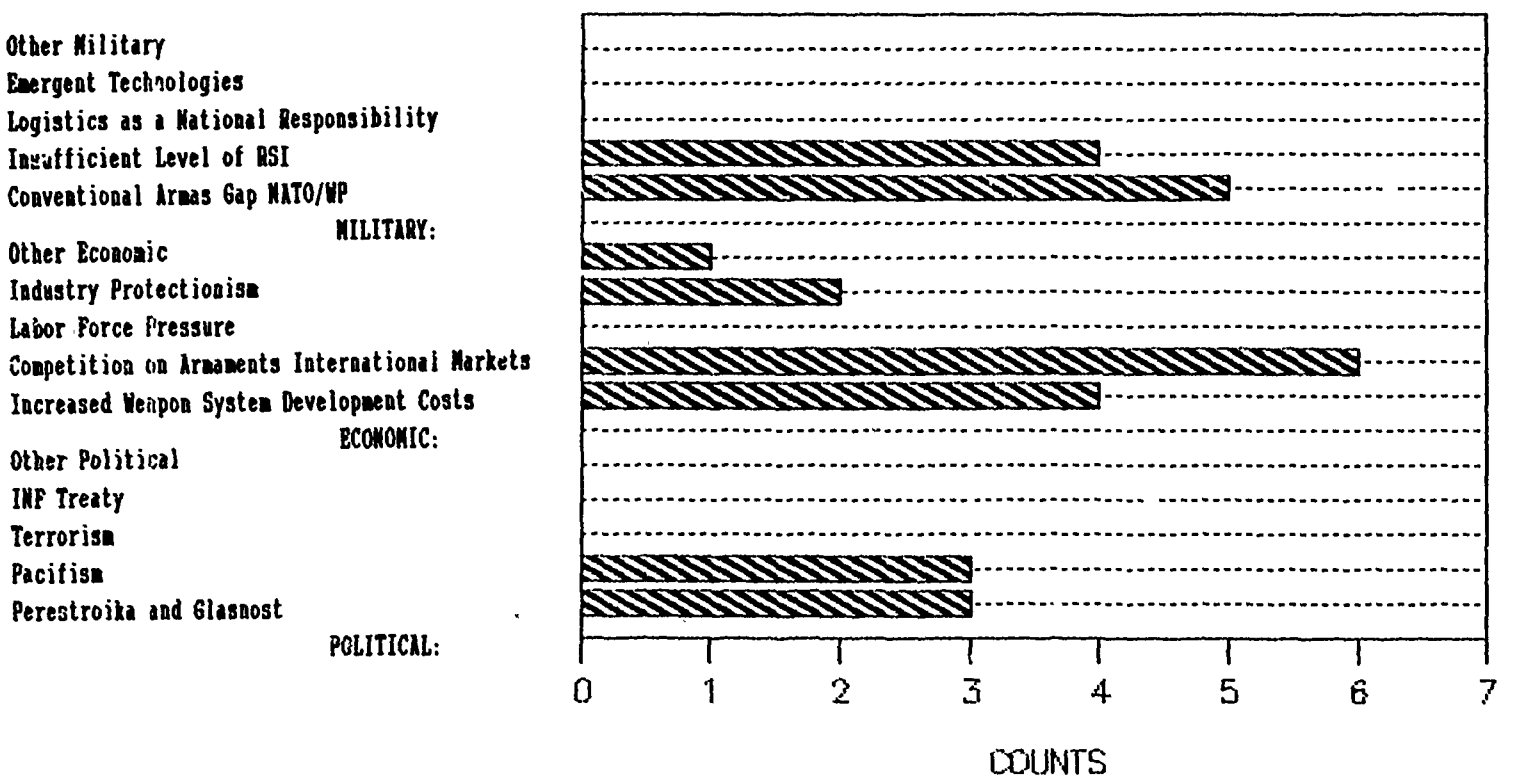
ENVIRONMENT PERCEPTION

1ST RANK OF TOP FIVE



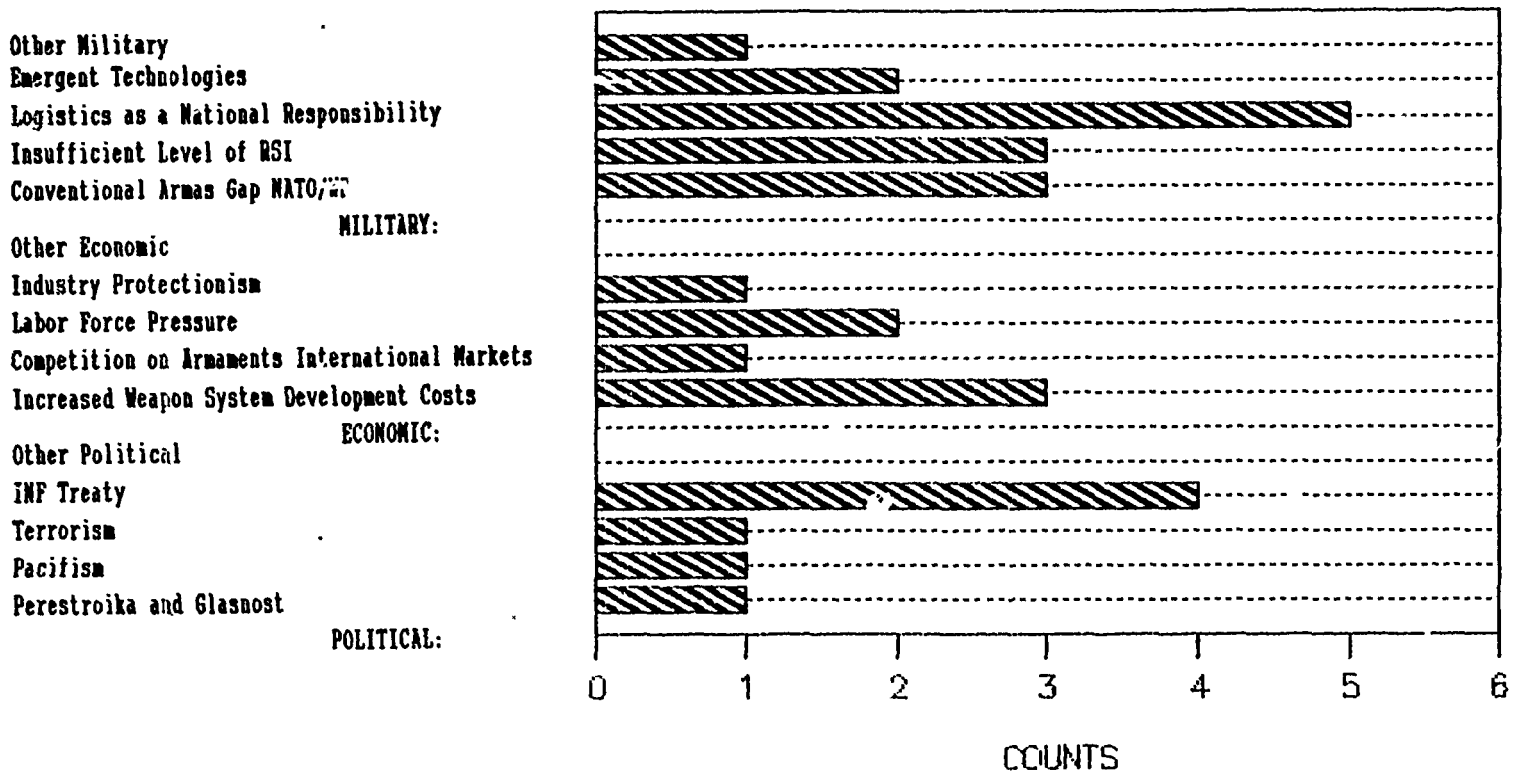
ENVIRONMENT PERCEPTION

2ND RANK OF TOP FIVE



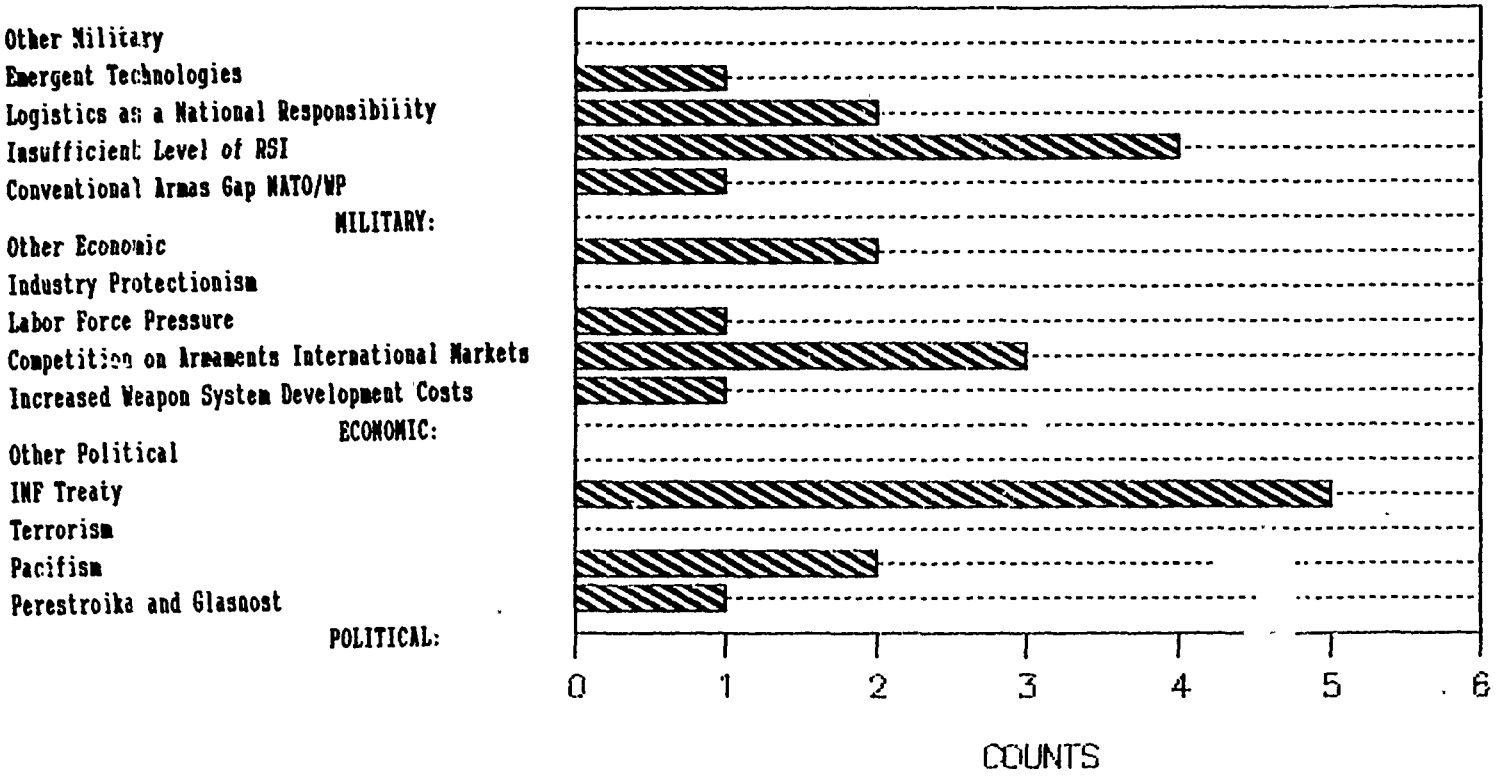
ENVIRONMENT PERCEPTION

3RD RANK OF TOP FIVE



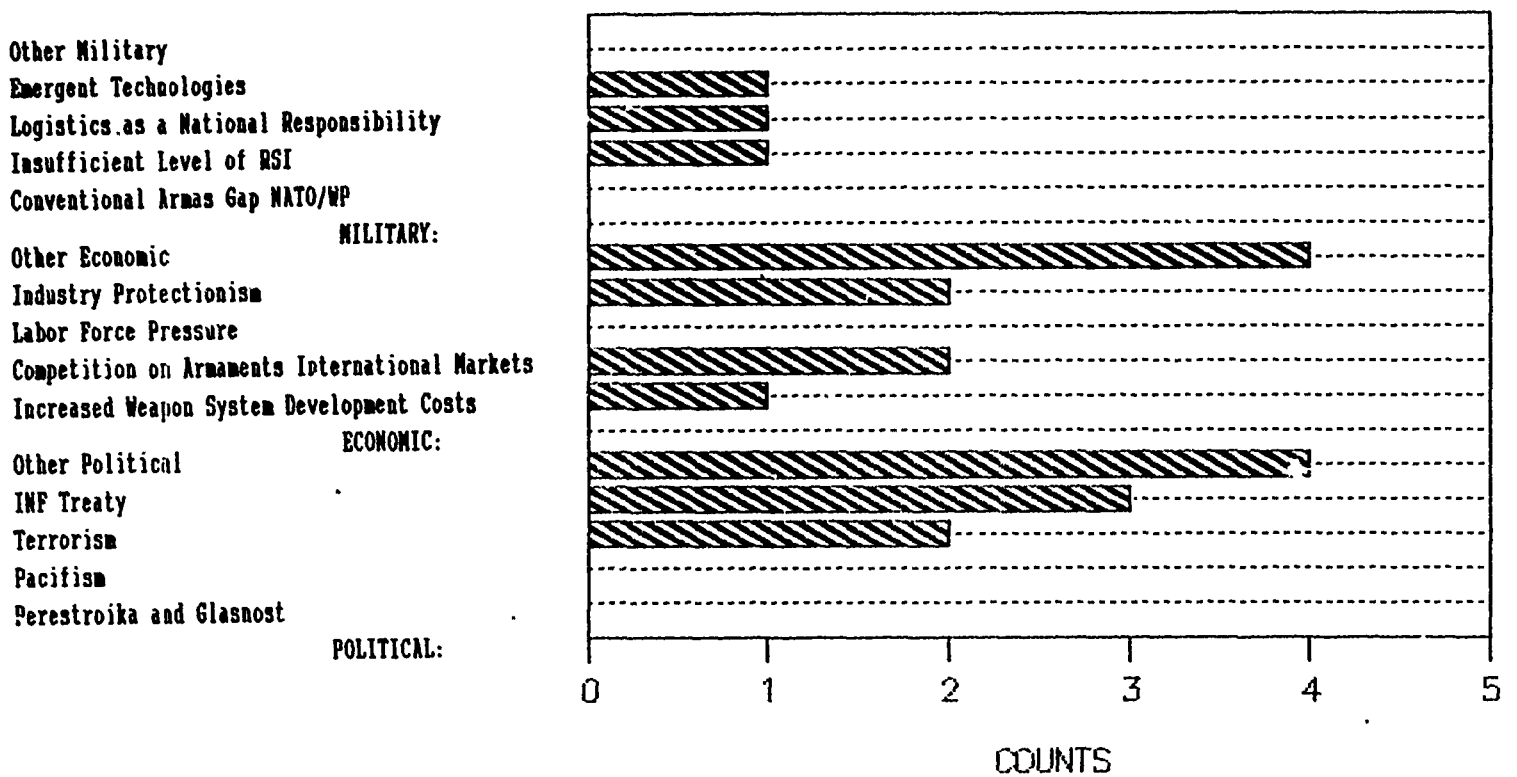
ENVIRONMENT PERCEPTION

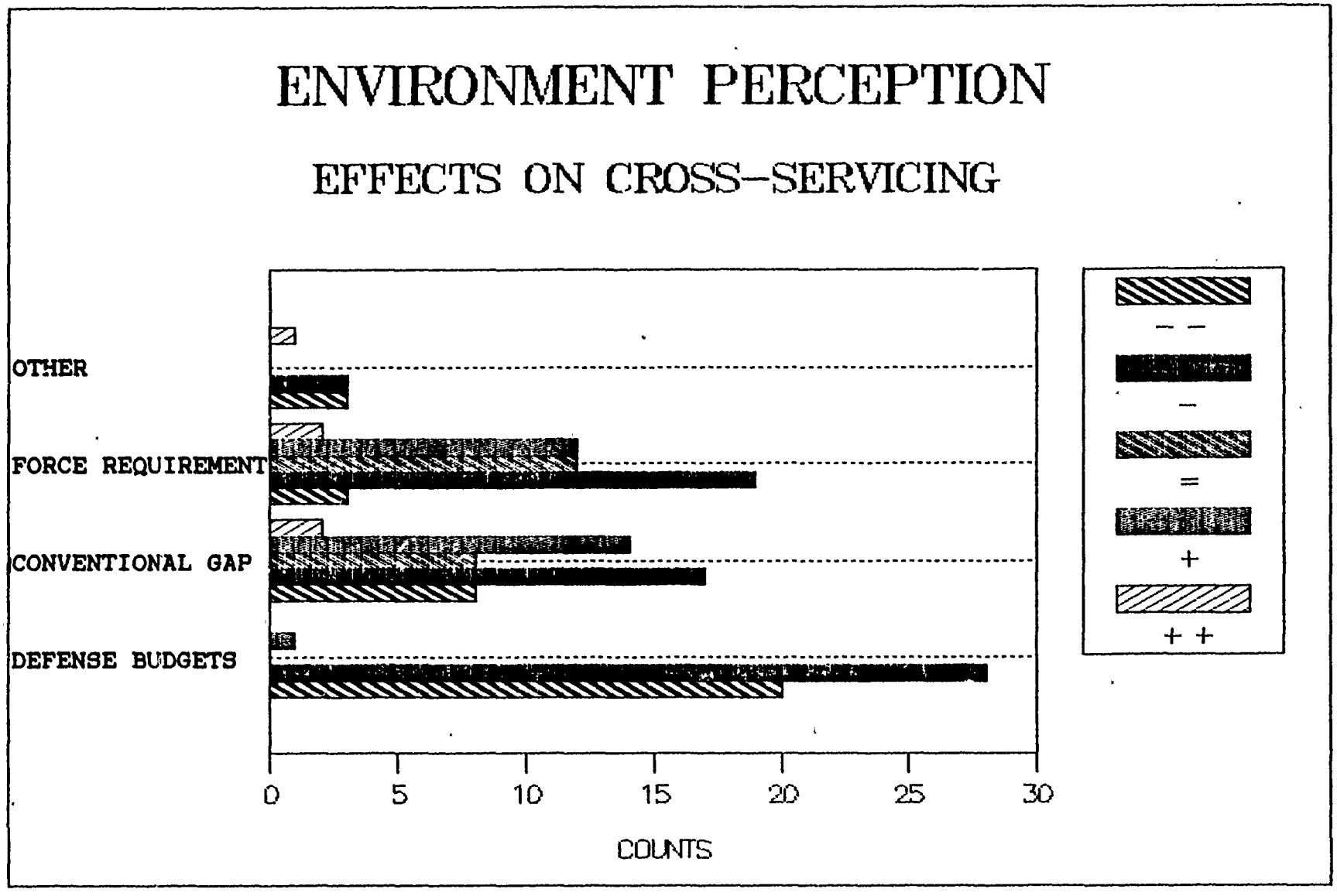
4TH RANK OF TOP FIVE

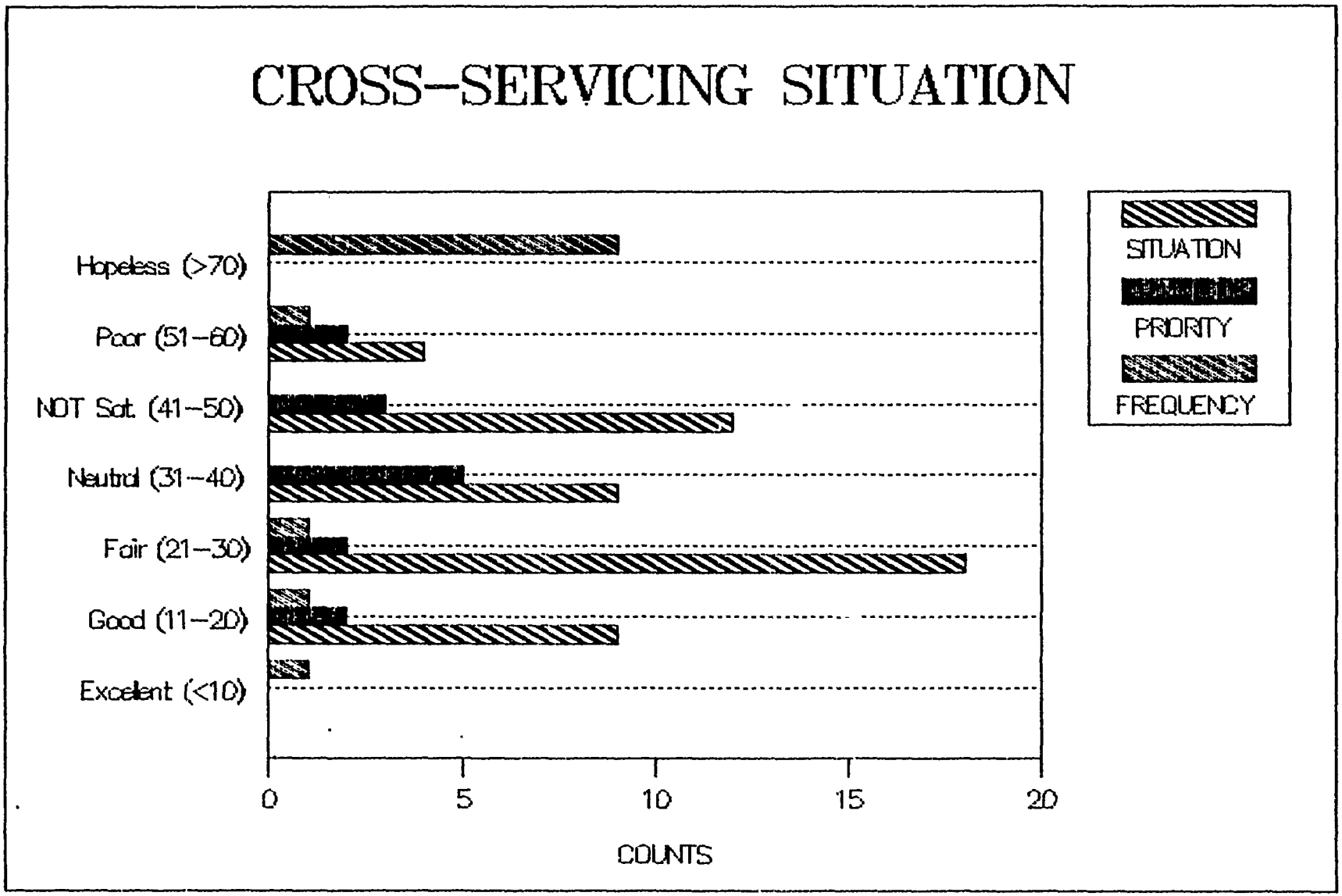


ENVIRONMENT PERCEPTION

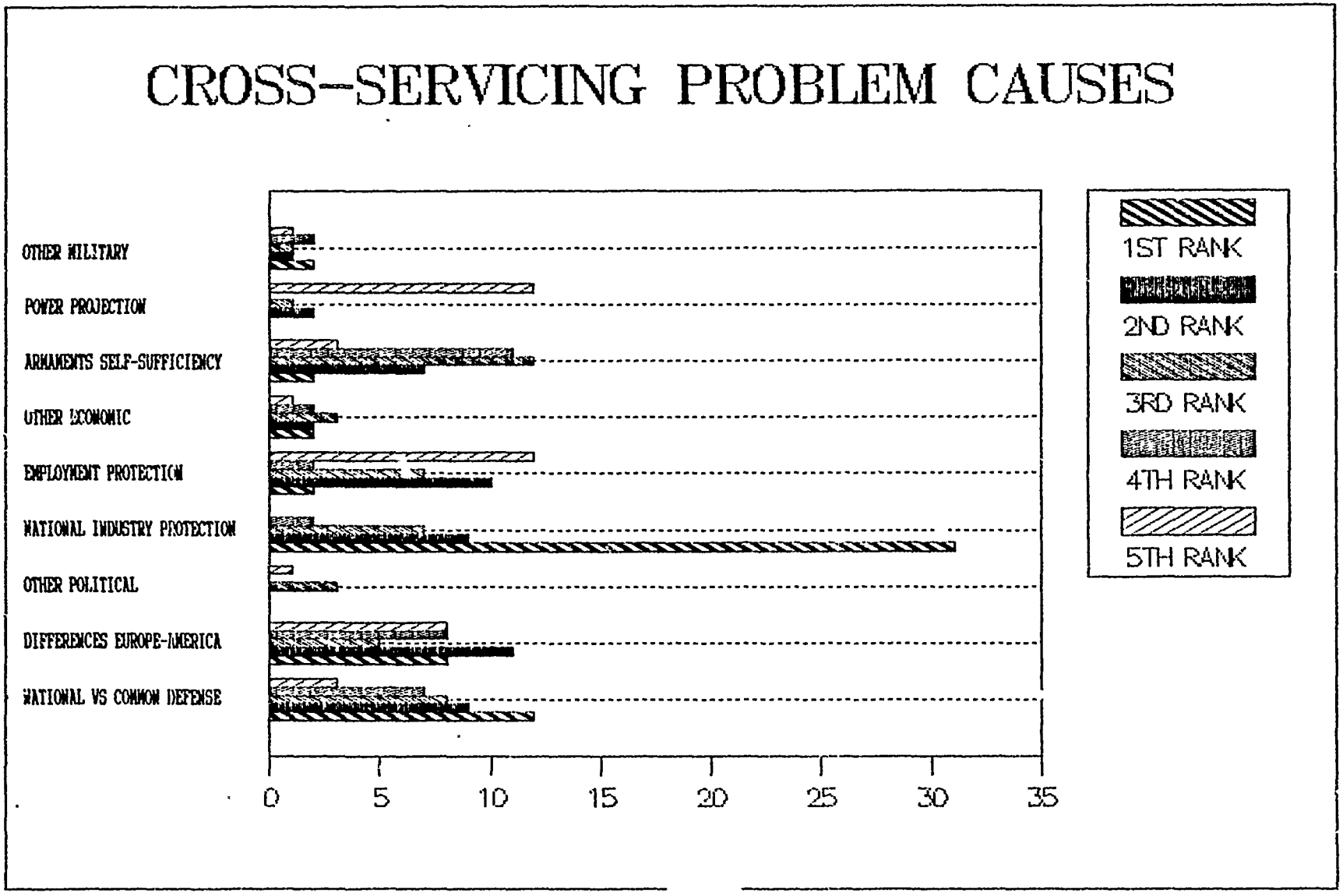
5TH RANK OF TOP FIVE

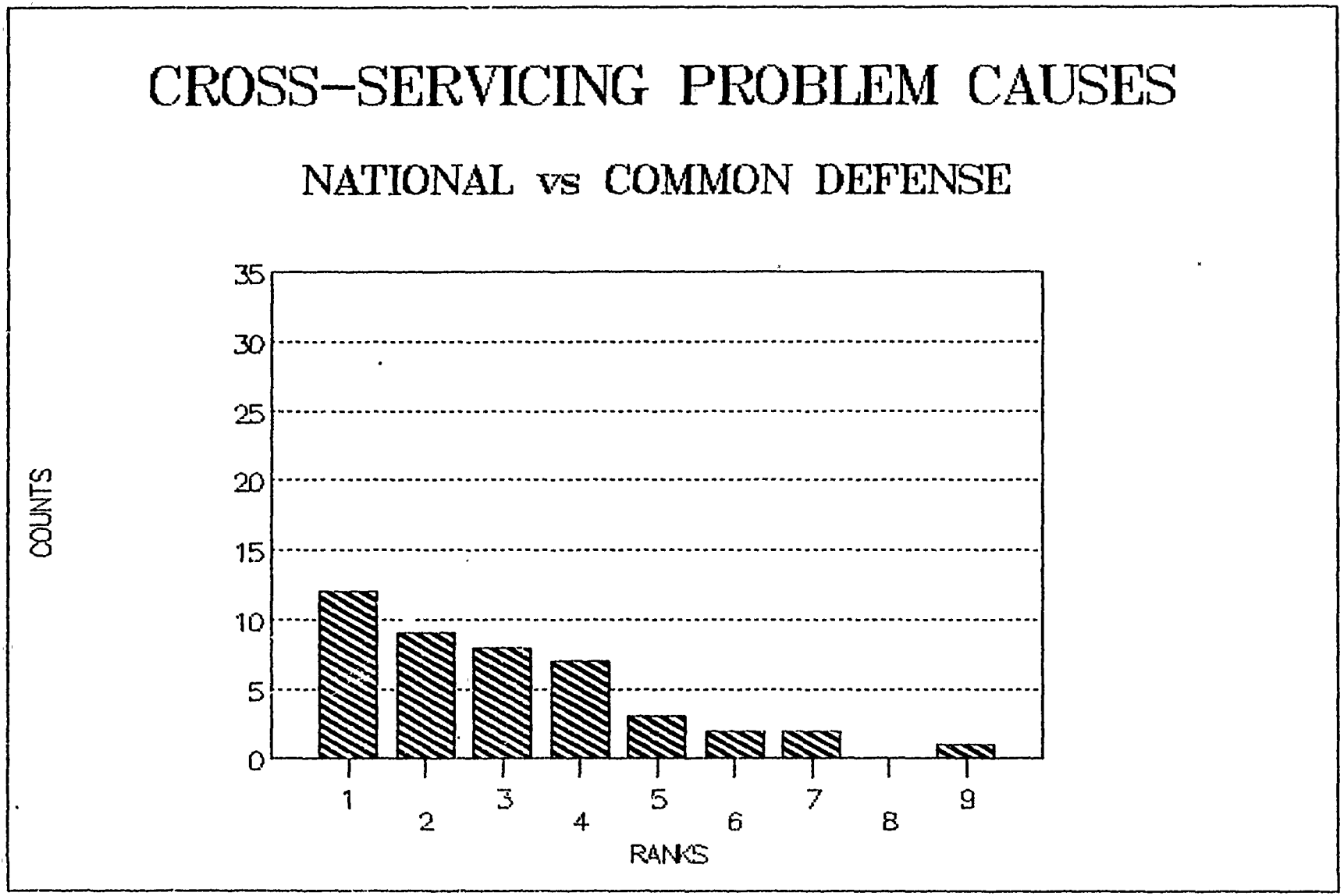



ENVIRONMENT PERCEPTION
EFFECTS ON CROSS-SERVICING
OTHER
FORCE REQUIREMENT
CONVENTIONAL GAP
DEFENSE BUDGETS
0
5
10
15
20
25
30
COUNTS
- -
-
=
+
+ +


CROSS-SERVICING SITUATION
Hopeless (>70)
Poor (51-60)
NOT Sat. (41-50)
Neutral (31-40)
Fair (21-30)
Good (11-20)
Excelent (<10)
0
5
10
15
20
COUNTS
SITUATION
PRIORITY
FREQUENCY

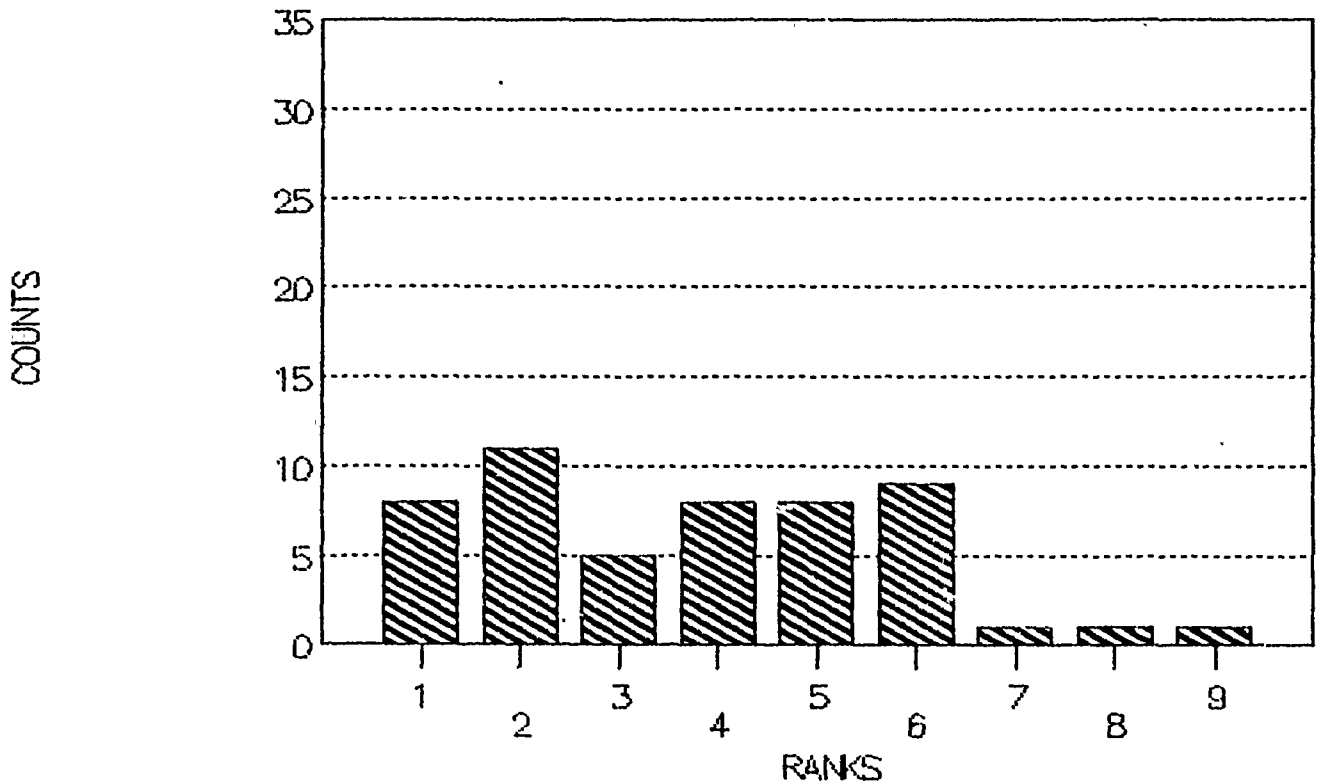
CROSS-SERVICING PROBLEM CAUSES




CROSS-SERVICING PROBLEM CAUSES
NATIONAL vs COMMON DEFENSE
COUNTS
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
RANKS

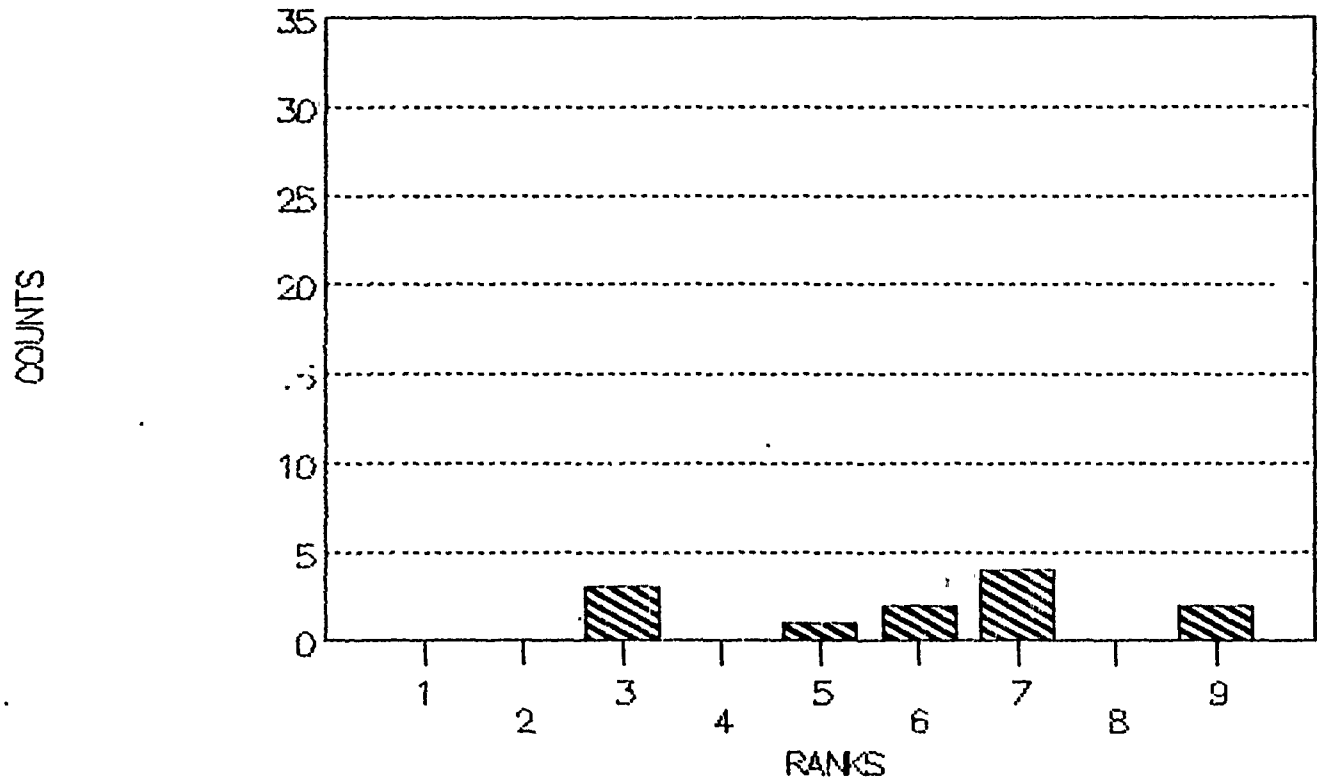
CROSS-SERVICING PROBLEM CAUSES

DIFFERENCES EUROPE-AMERICA



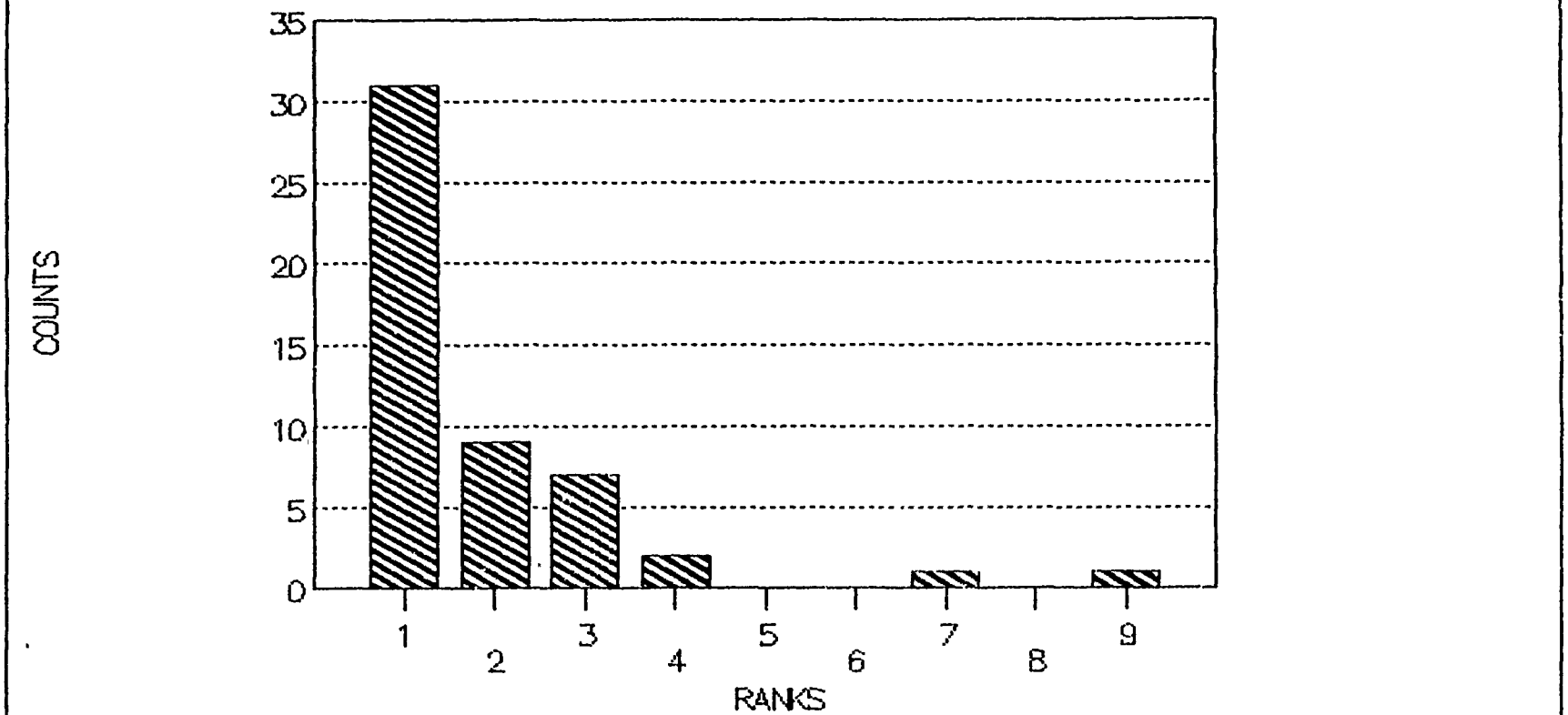
CROSS-SERVICING PROBLEM CAUSES

OTHER POLITICAL



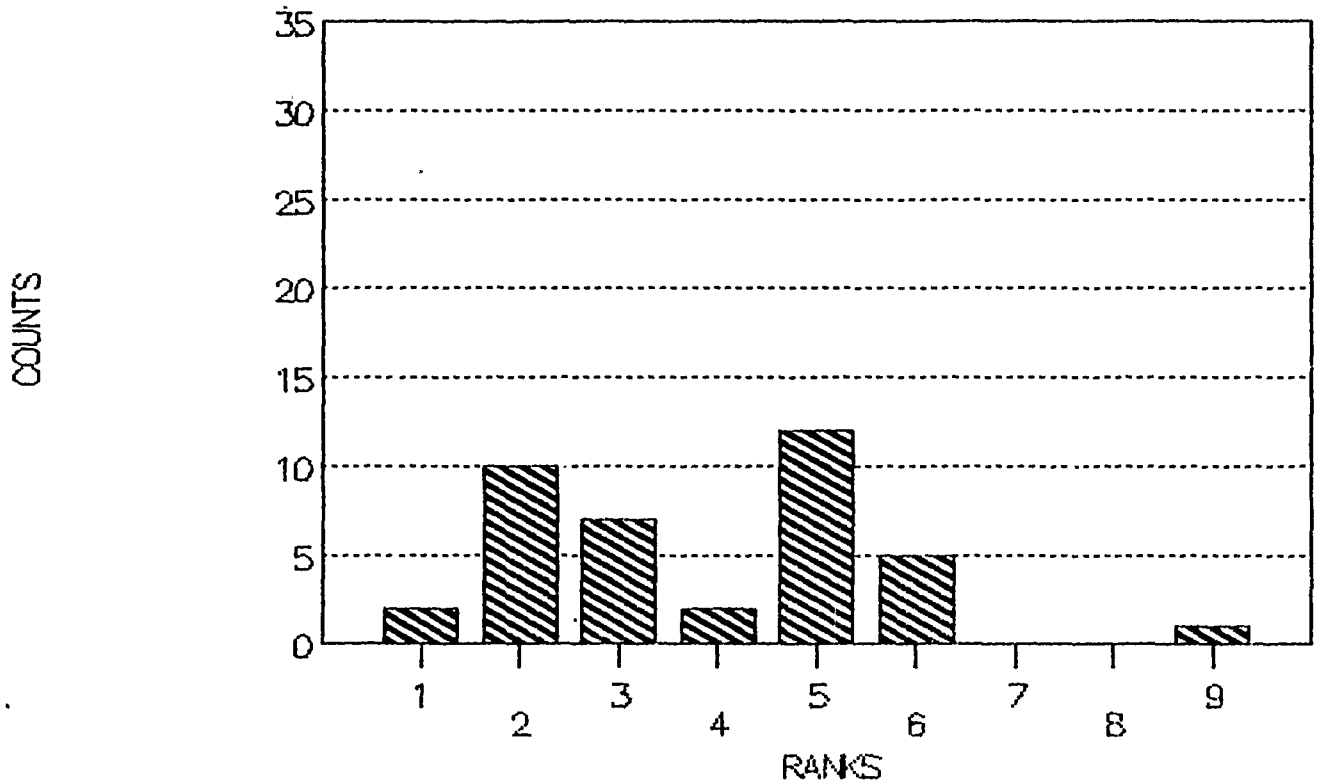
CROSS-SERVICING PROBLEM CAUSES

NATIONAL INDUSTRY PROTECTION



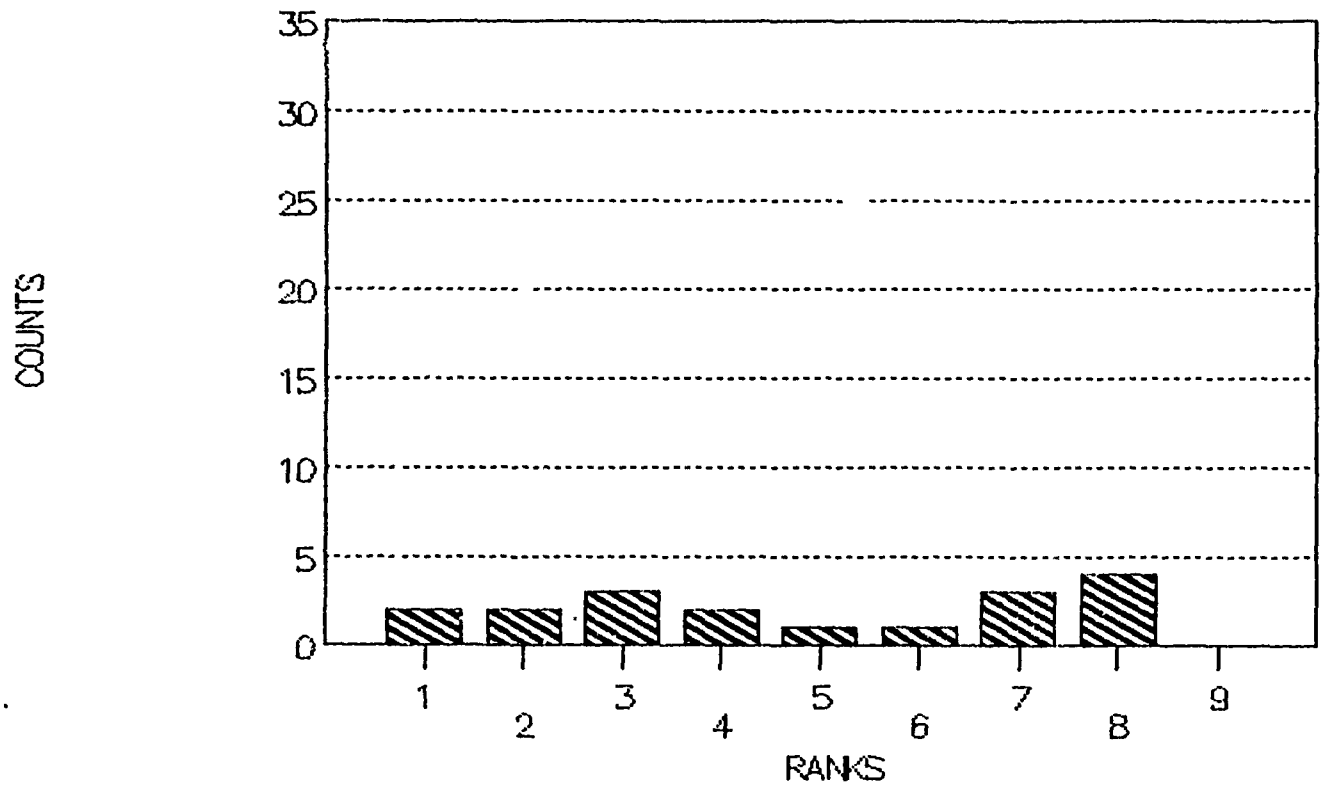
CROSS-SERVICING PROBLEM CAUSES

EMPLOYMENT PROTECTION



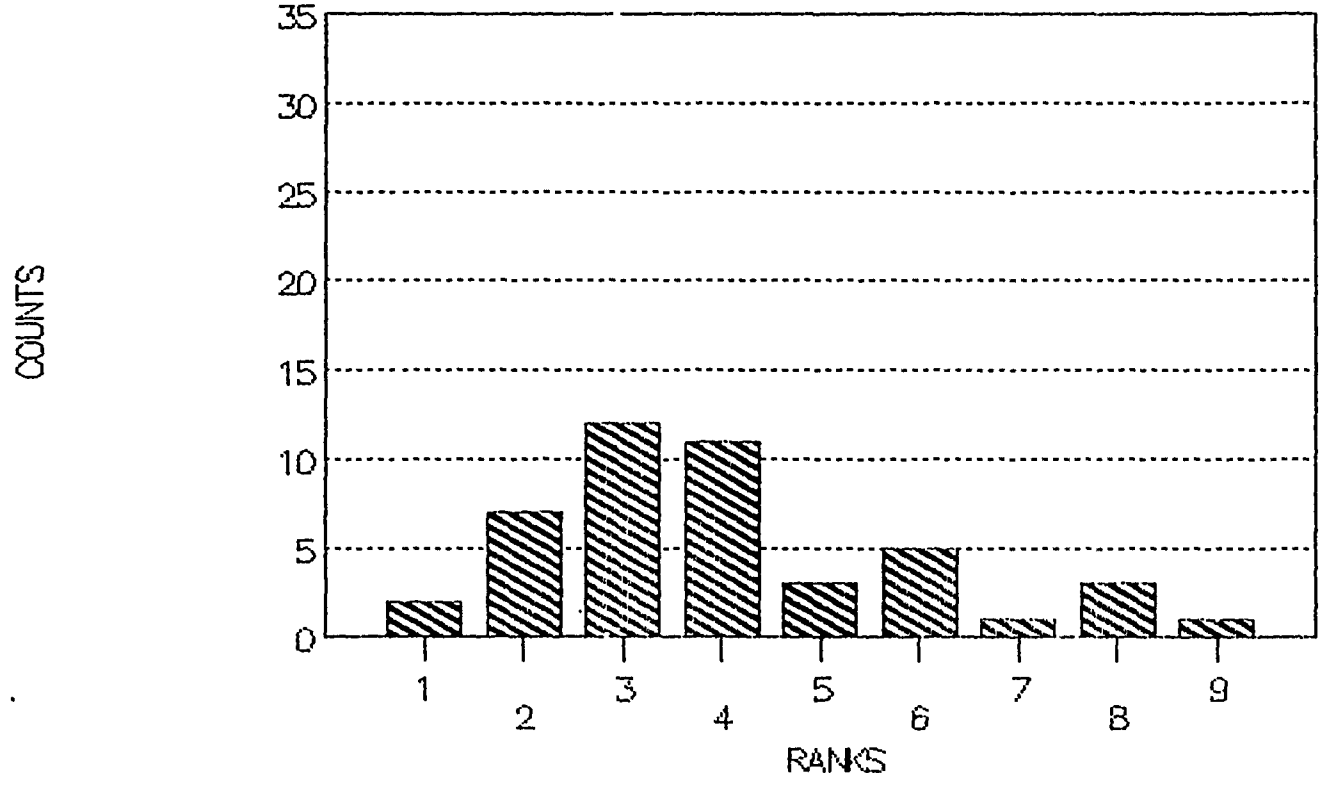
CROSS-SERVICING PROBLEM CAUSES

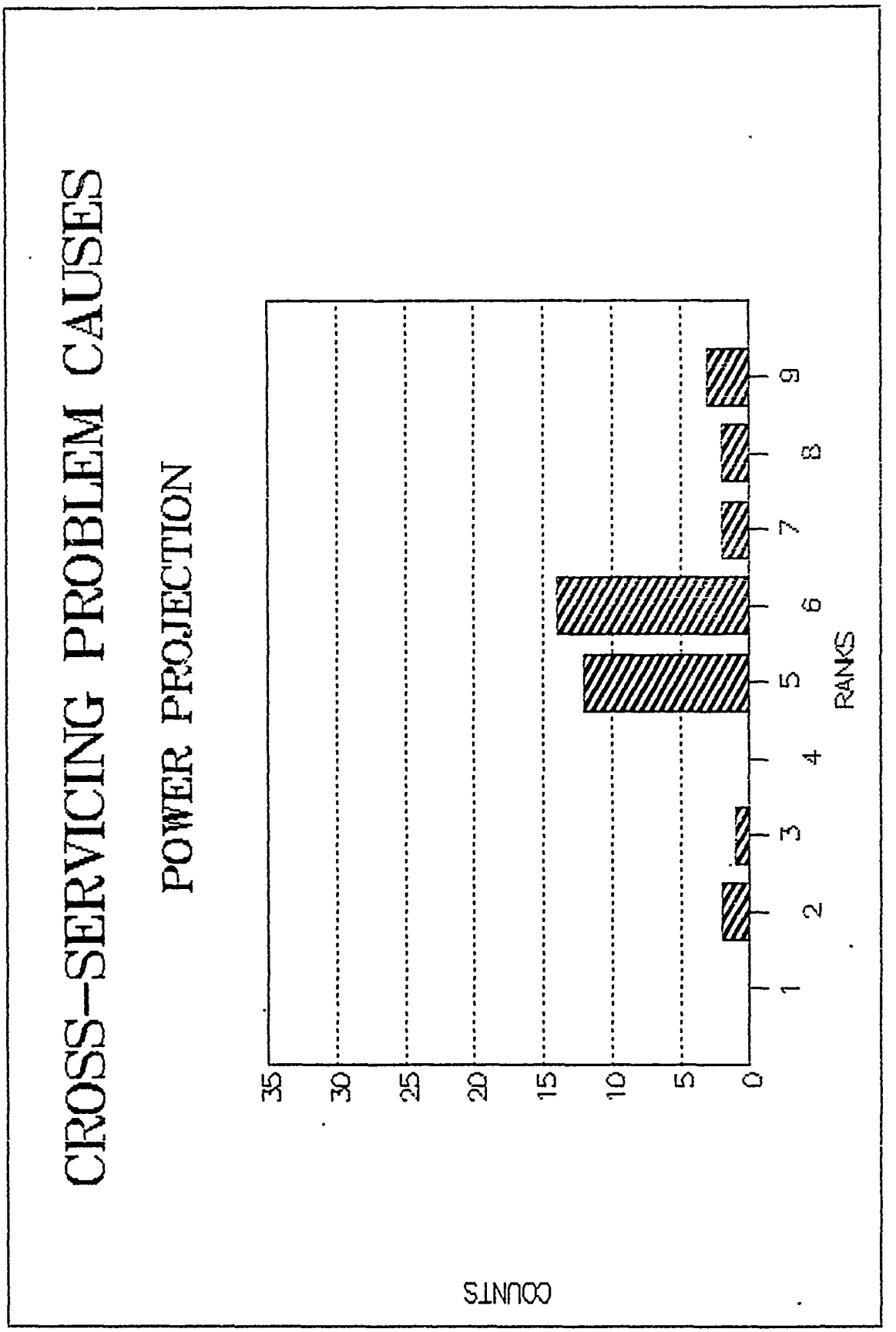
OTHER ECONOMIC



CROSS-SERVICING PROBLEM CAUSES

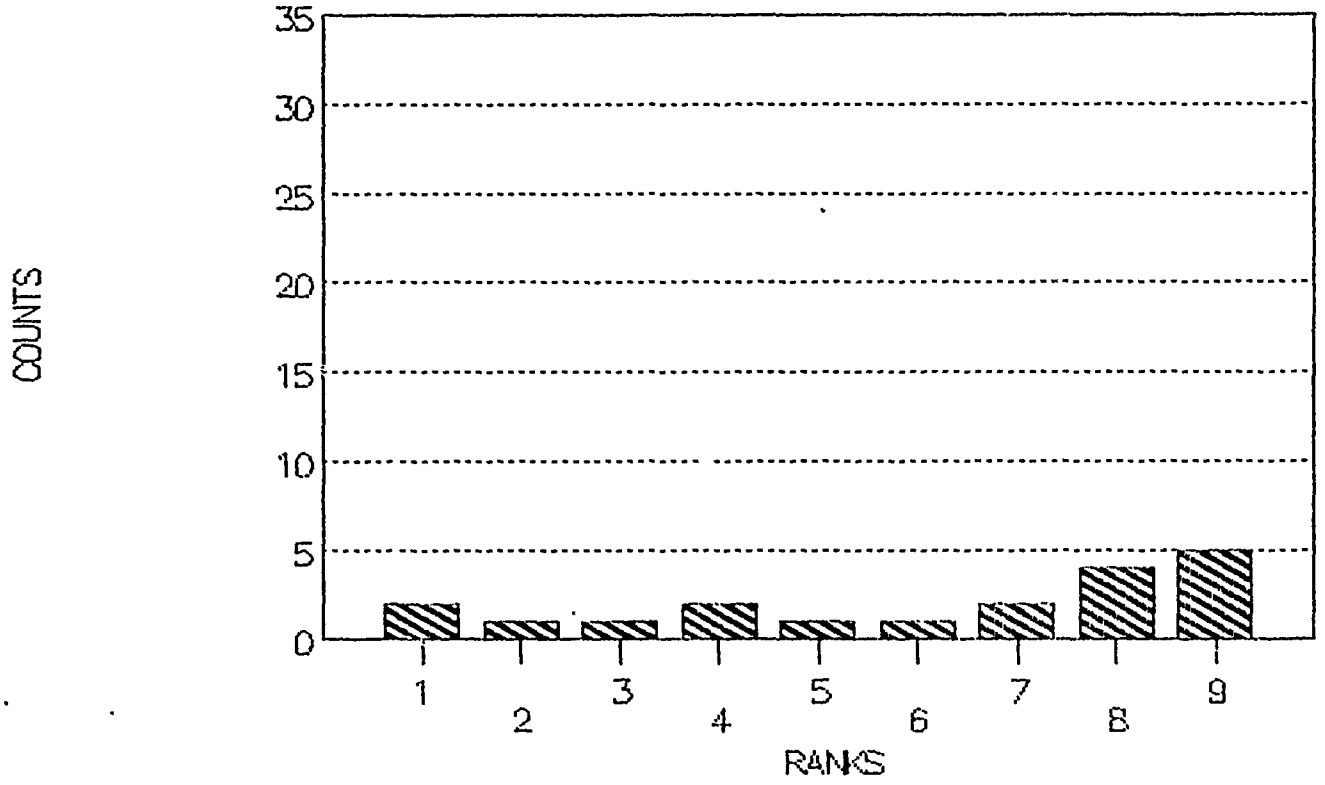
ARMAMENT SELF-SUFFICIENCY

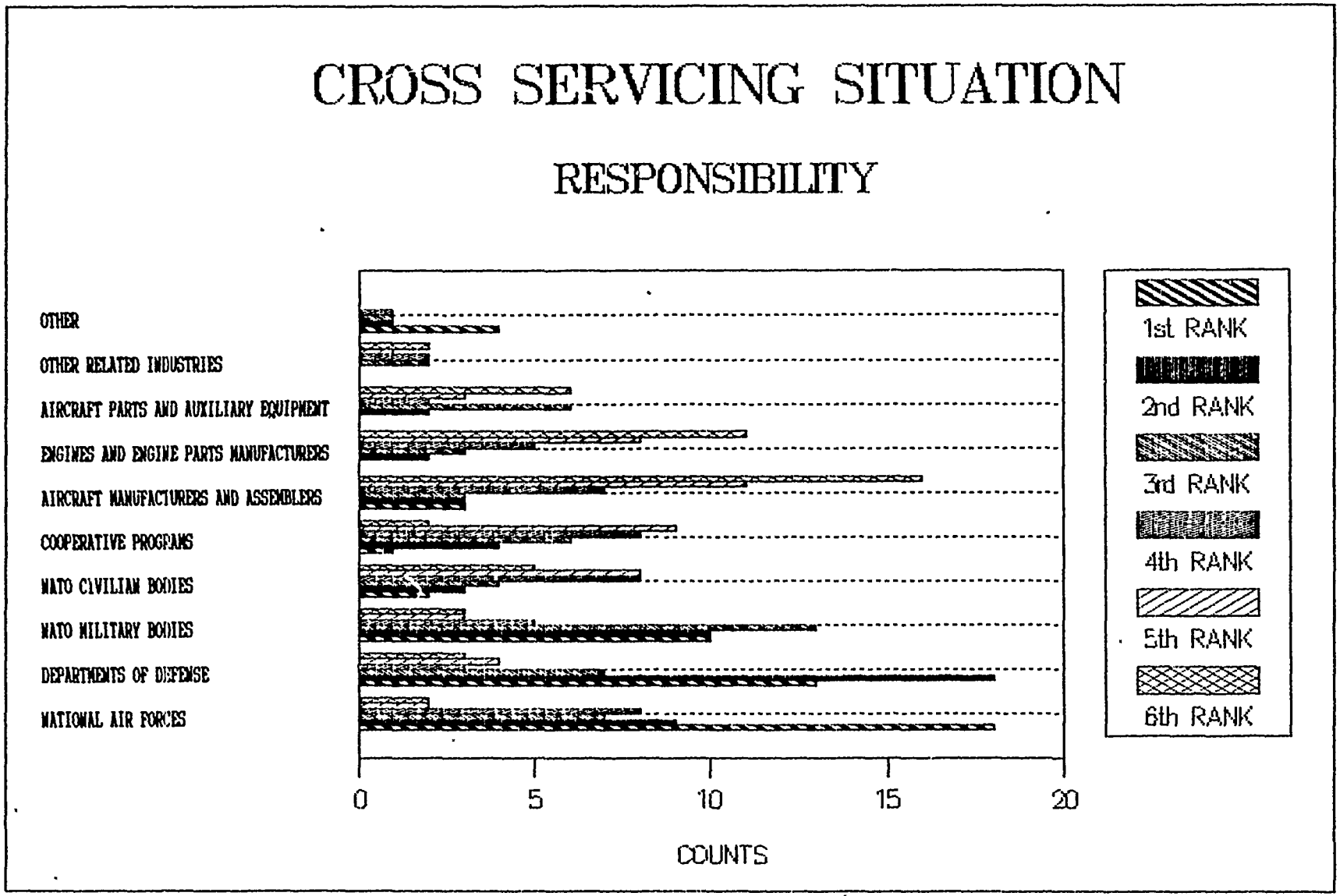



CROSS-SERVICING PROBLEM CAUSES
POWER PROJECTION
COUNTS
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
RANKS

CROSS-SERVICING PROBLEM CAUSES

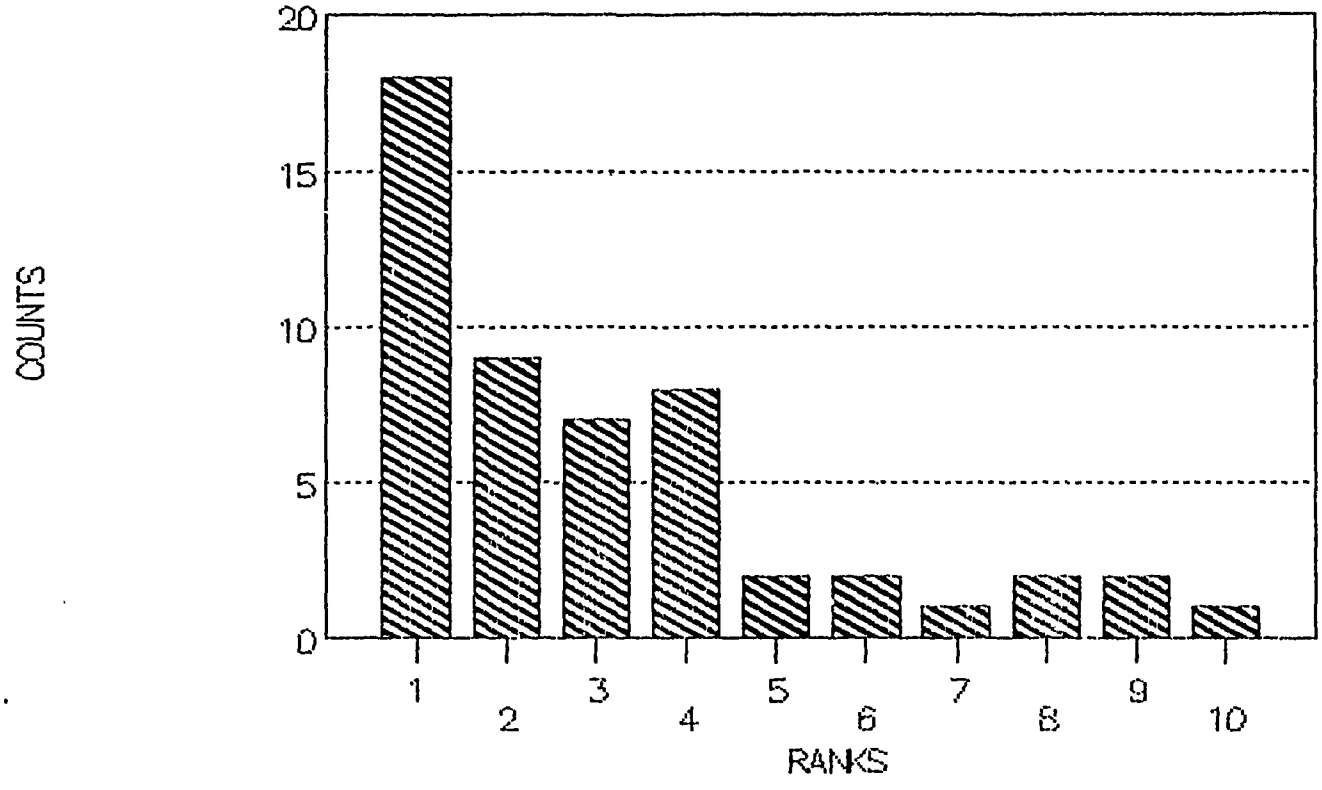
OTHER MILITARY




CROSS SERVICING SITUATION
RESPONSIBILITY
OTHER
OTHER RELATED INDUSTRIES
AIRCRAFT PARTS AND AUXILIARY EQUIPMENT
ENGINES AND ENGINE PARTS MANUFACTURERS
AIRCRAFT MANUFACTURERS AND ASSEMBLERS
COOPERATIVE PROGRAMS
NATO CIVILIAN BODIES
NATO MILITARY BODIES
DEPARTMENTS OF DEFENSE
NATIONAL AIR FORCES
0
5
10
15
20
COUNTS
1st RANK
2nd RANK
3rd RANK
4th RANK
5th RANK
6th RANK

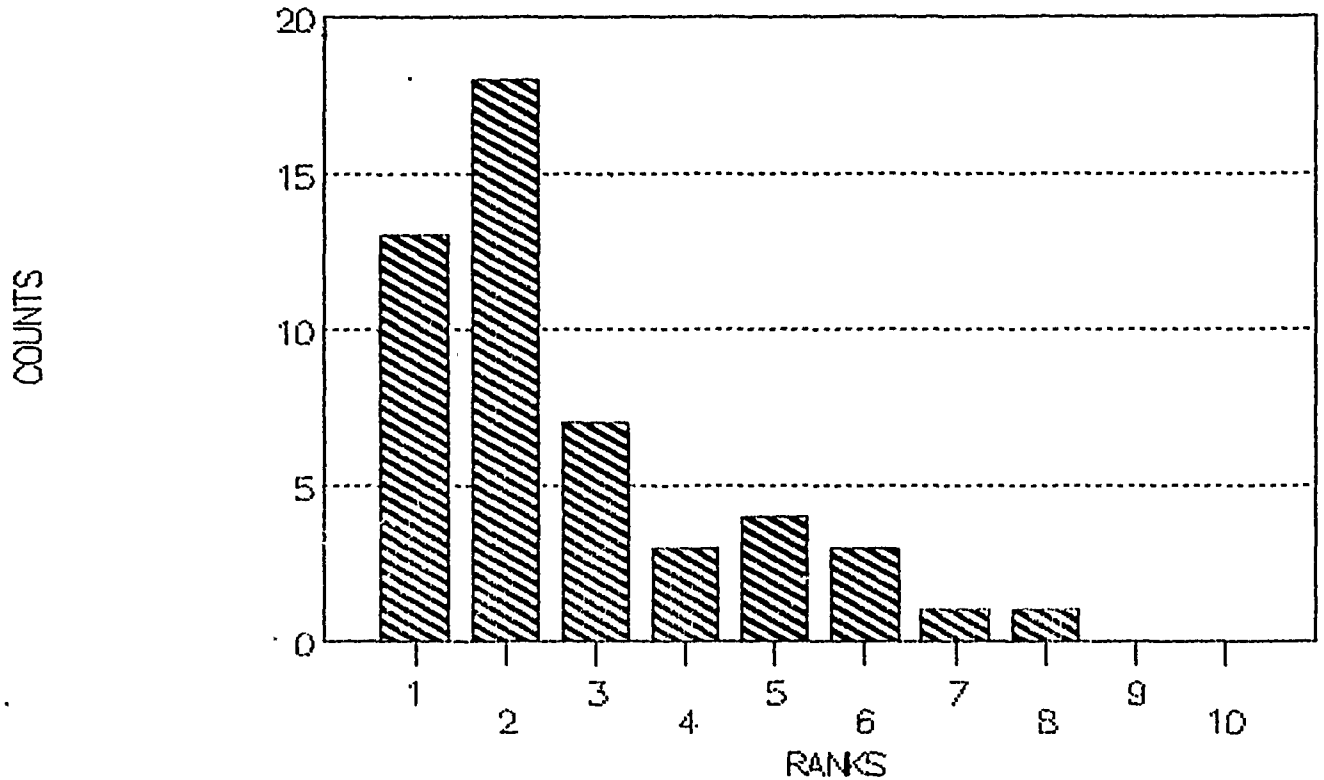
SITUATION RESPONSIBILITY

NATIONAL AIR FORCES



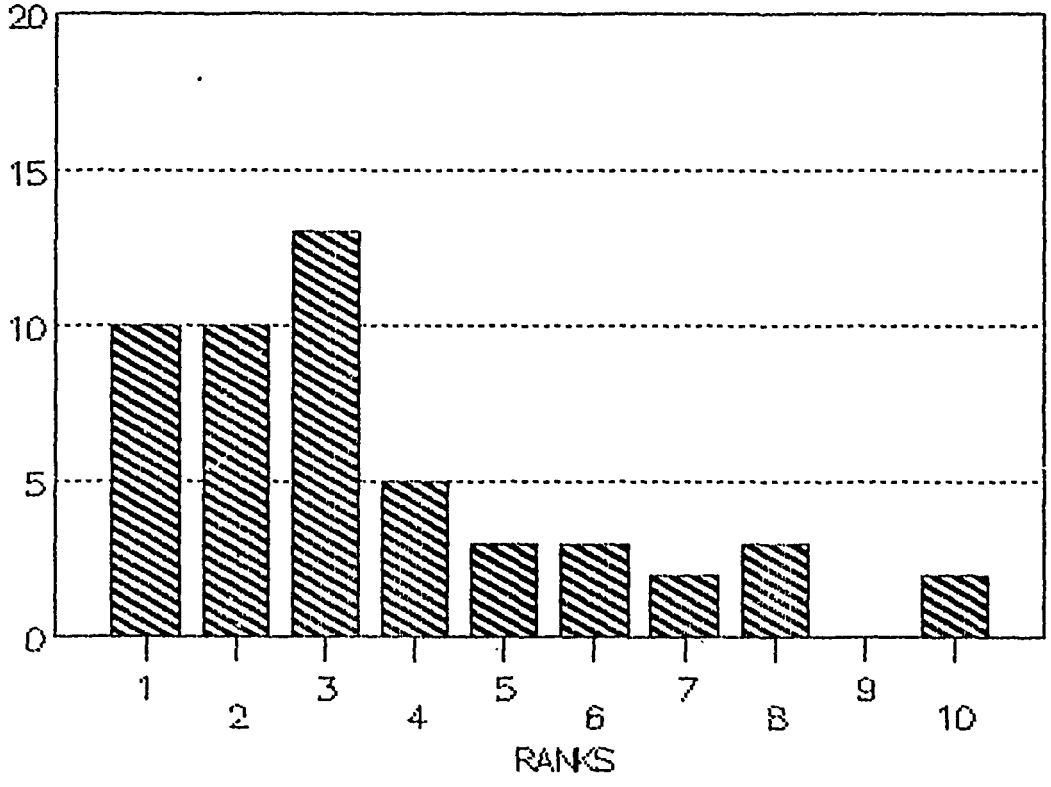
SITUATION RESPONSIBILITY

DEPARTMENTS OF DEFENSE



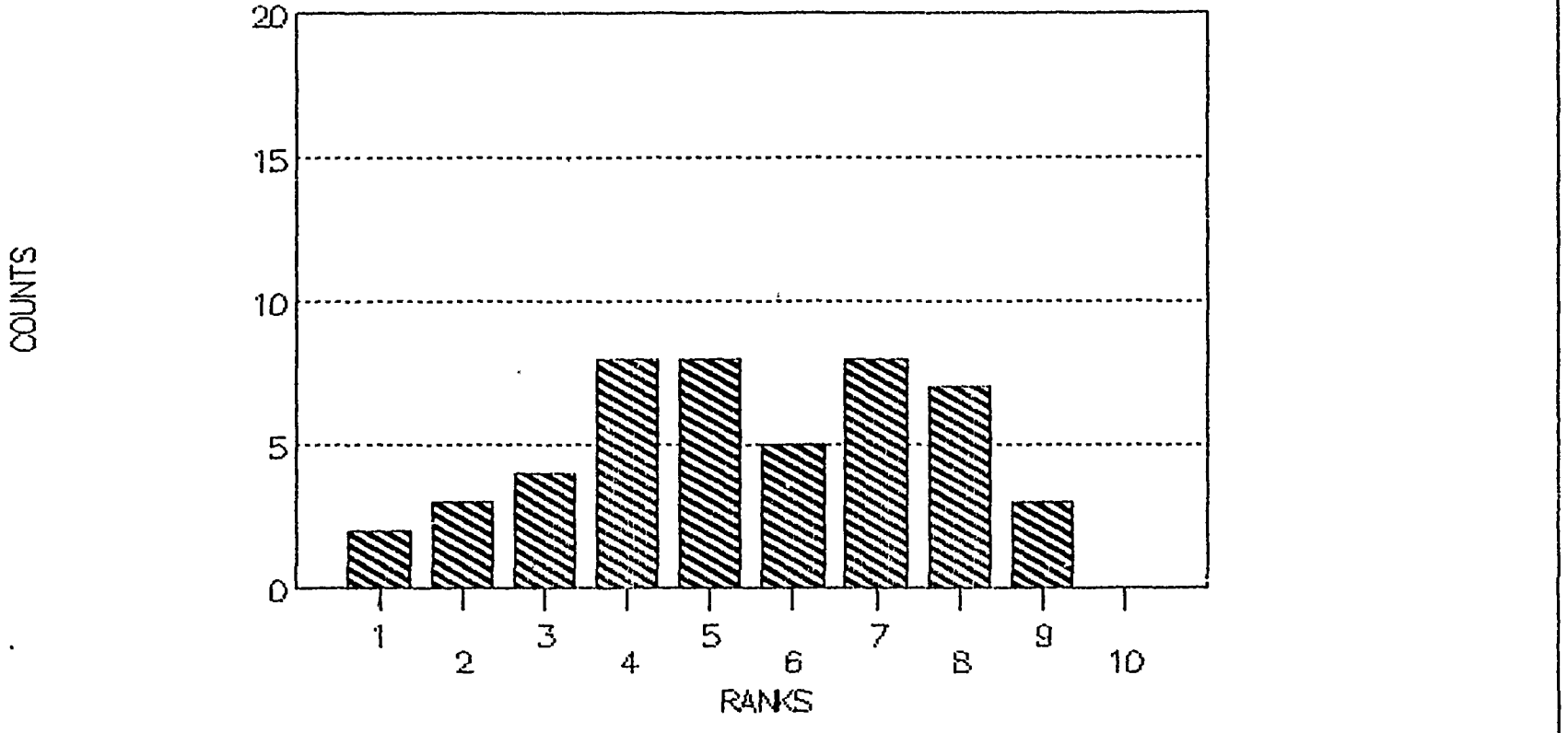
SITUATION RESPONSIBILITY

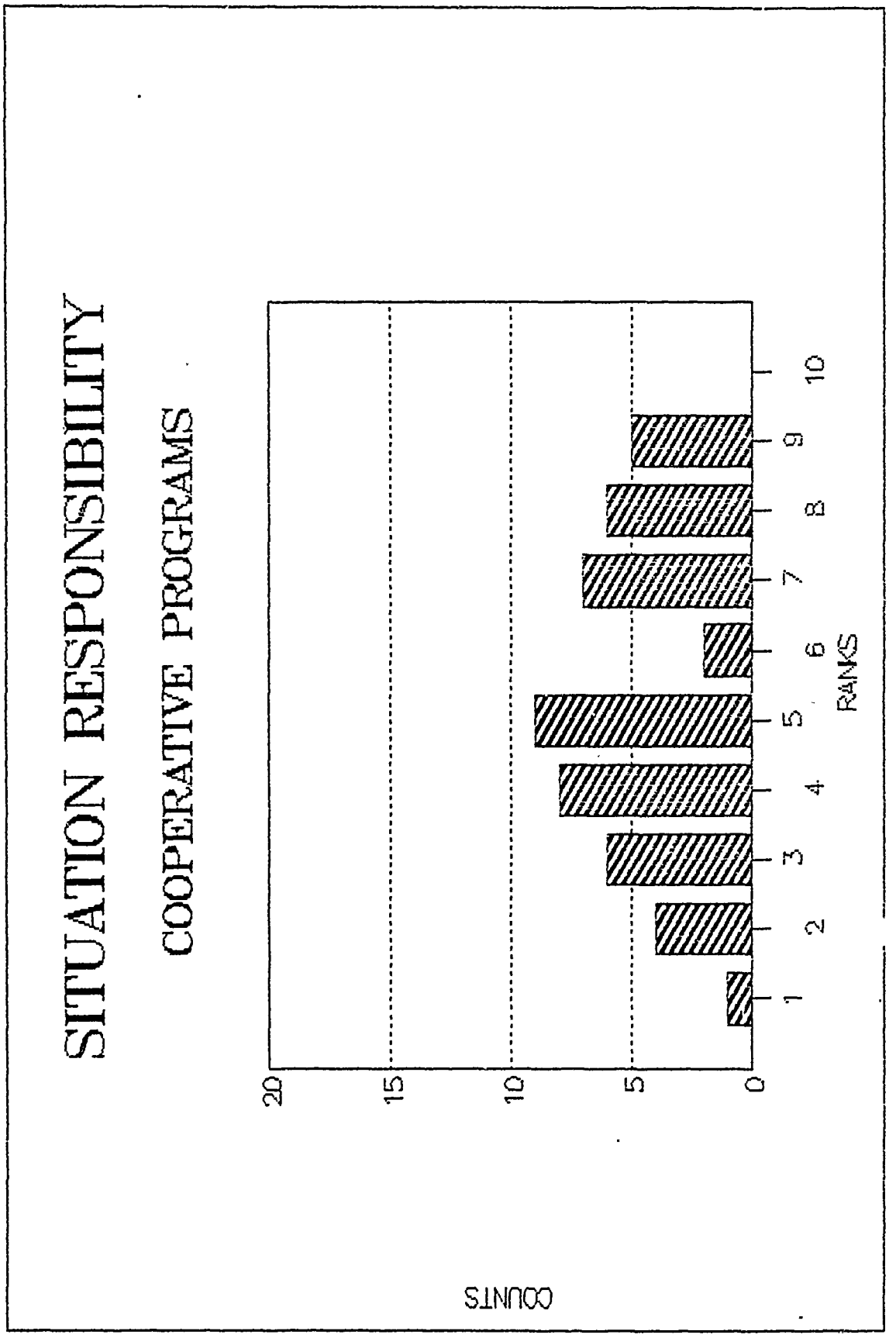
NATO MILITARY BODIES



SITUATION RESPONSIBILITY

NATO CIVILIAN BODIES




SITUATION RESPONSIBILITY
COOPERATIVE PROGRAMS
COUNTS
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10
5
0
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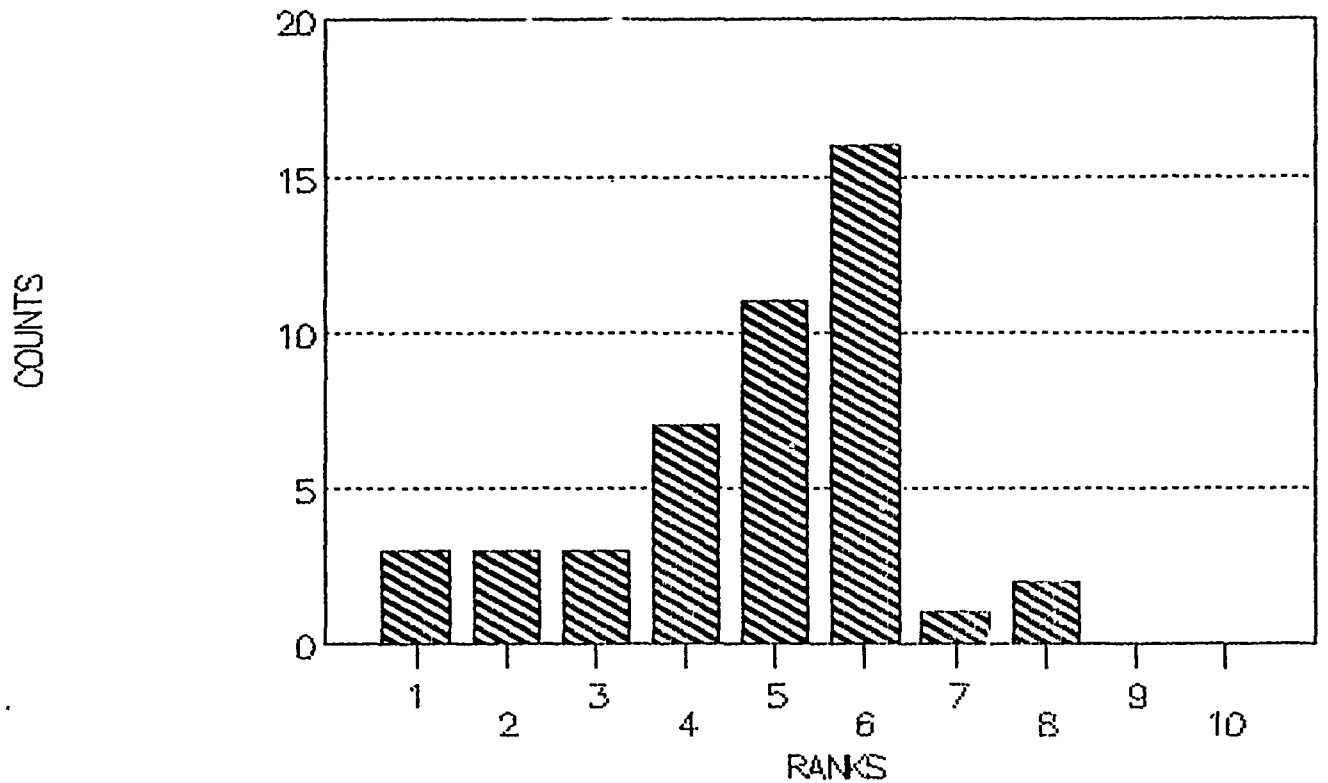
10
RANKS

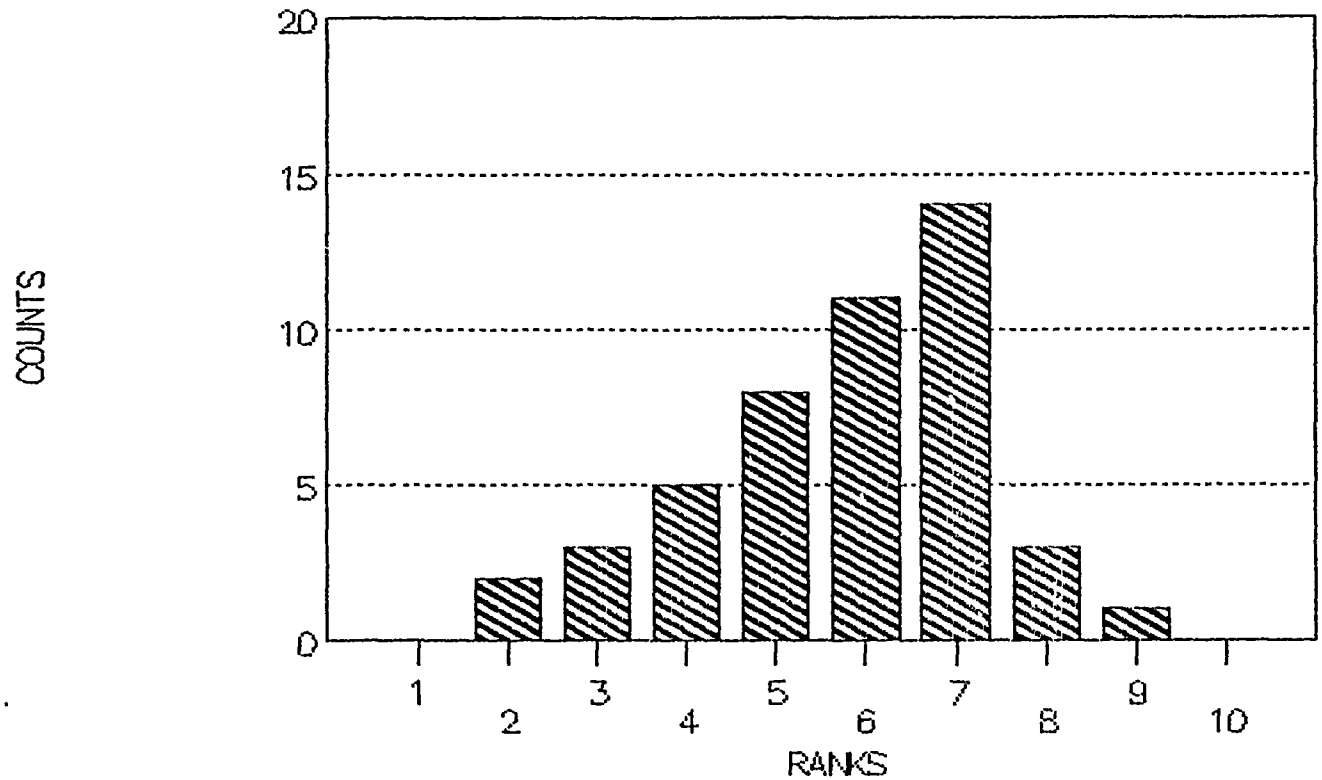
SITUATION RESPONSIBILITY

AIRCRAFT MANUFACTURERS AND ASSEMBLERS



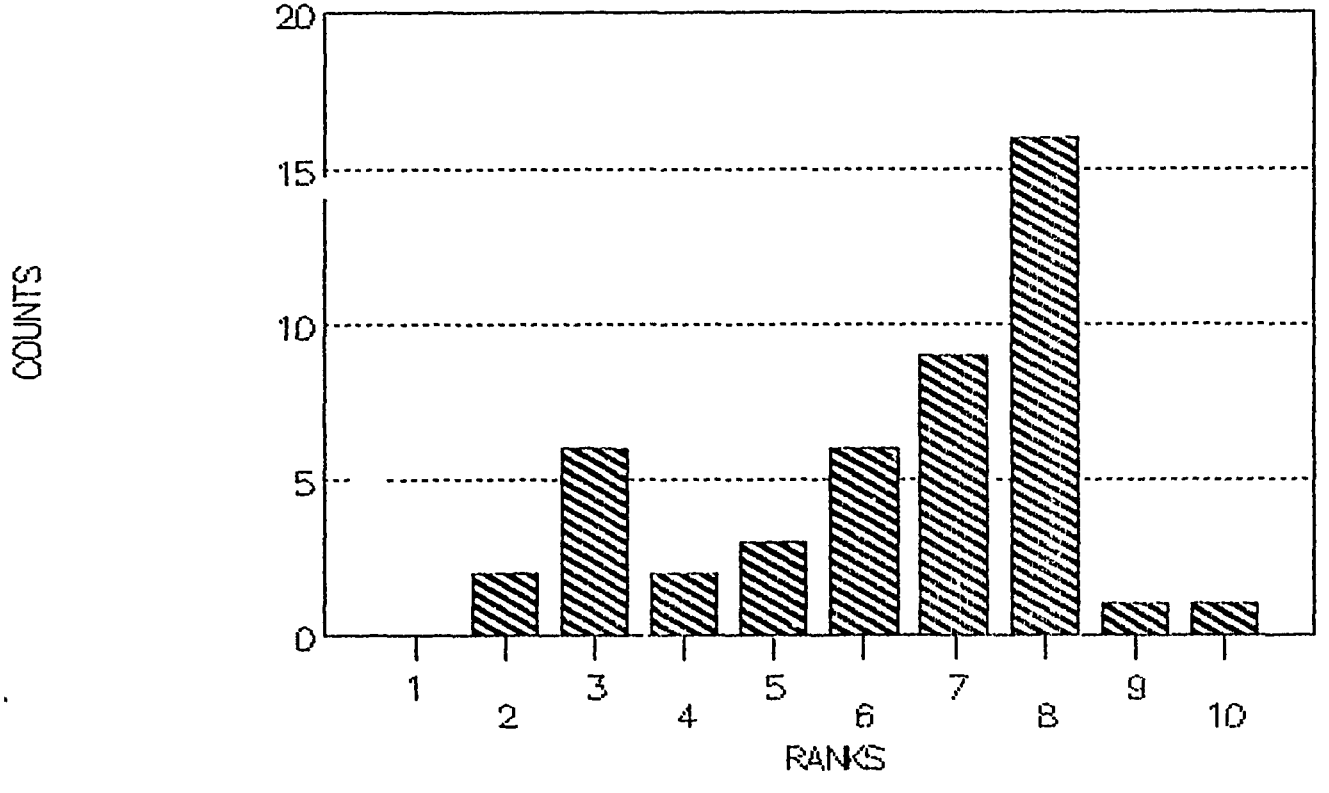
SITUATION RESPONSIBILITY

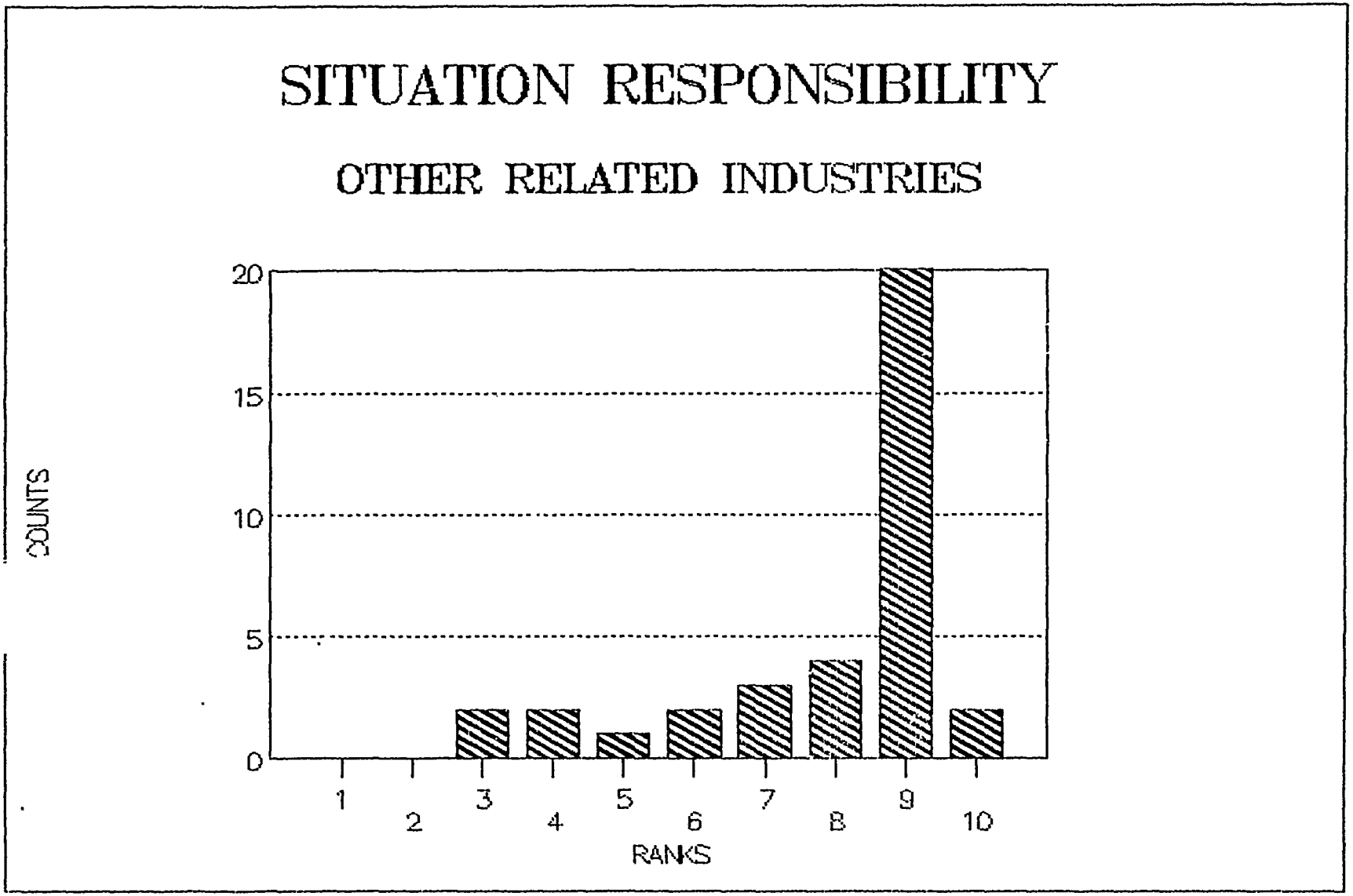
ENGINES AND ENGINE PARTS MANUFACTURERS



SITUATION RESPONSIBILITY

AIRCRAFT PARTS AND AUXILIARY EQUIPMENT




SITUATION RESPONSIBILITY
OTHER RELATED INDUSTRIES
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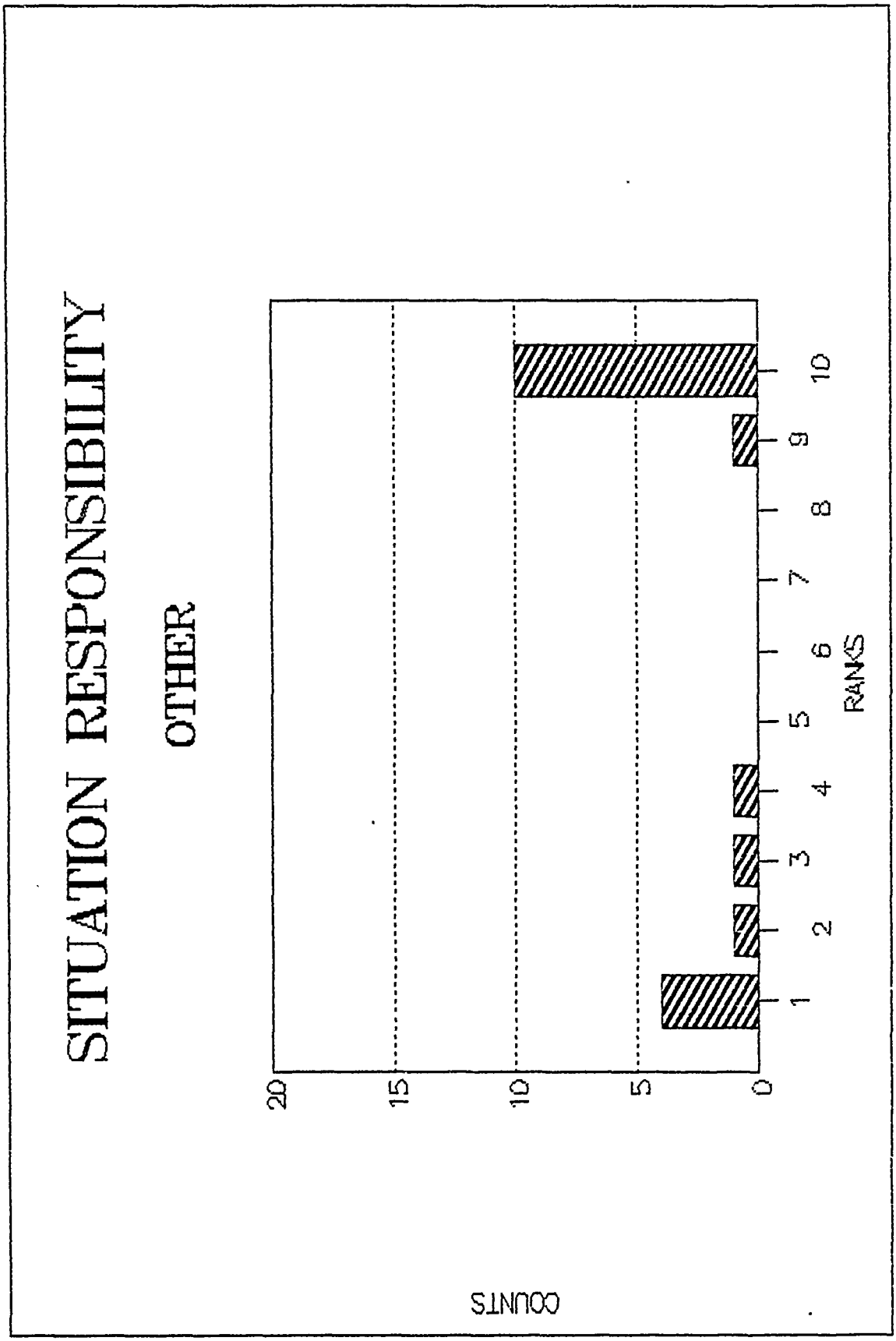
10
RANKS


SITUATION RESPONSIBILITY
OTHER
COUNTS
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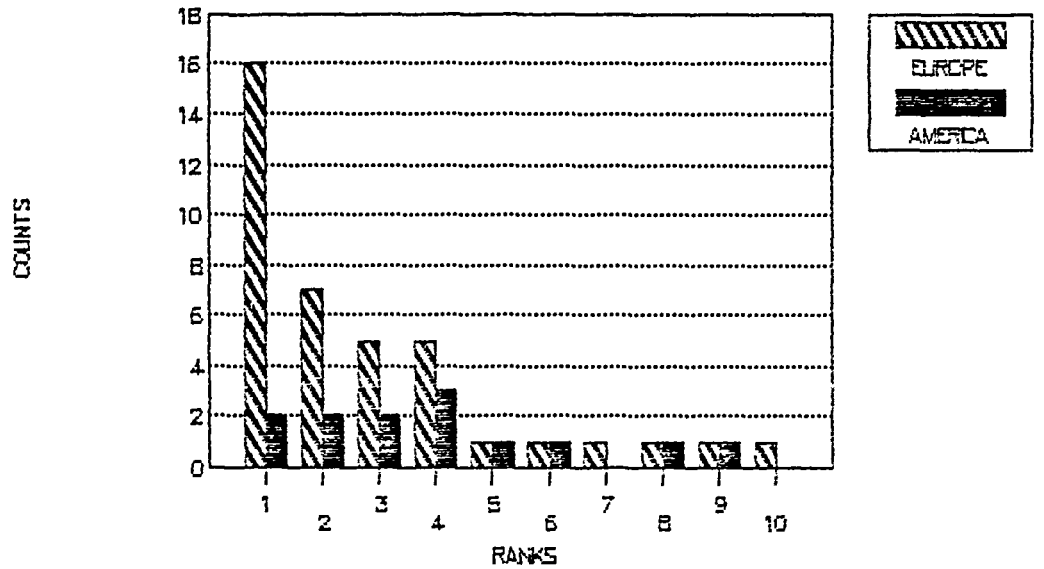
10
RANKS

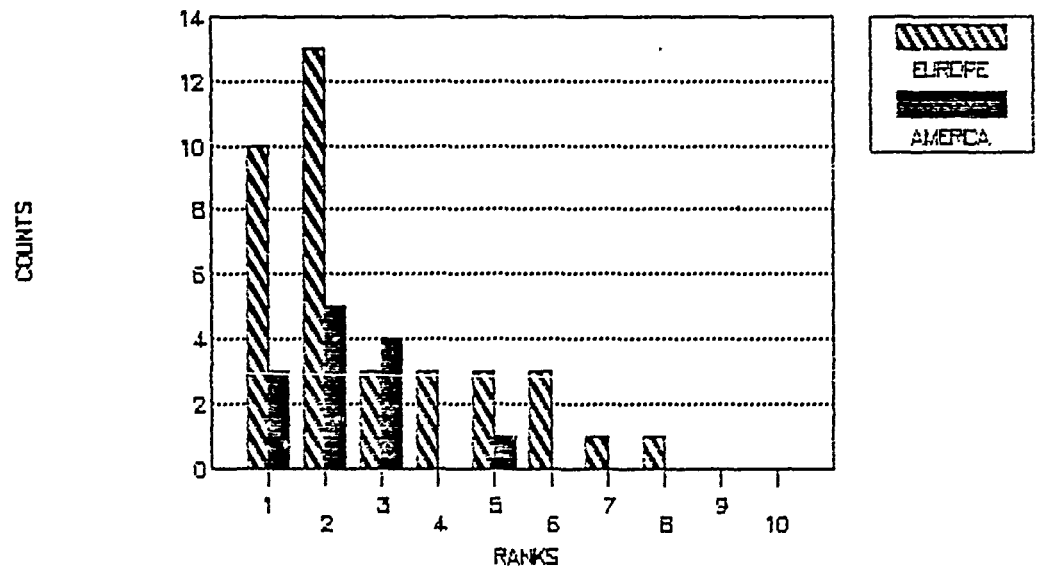
CROSS-SERV. SITUATION RESPONSIBILITY

NATIONAL AIR FORCES



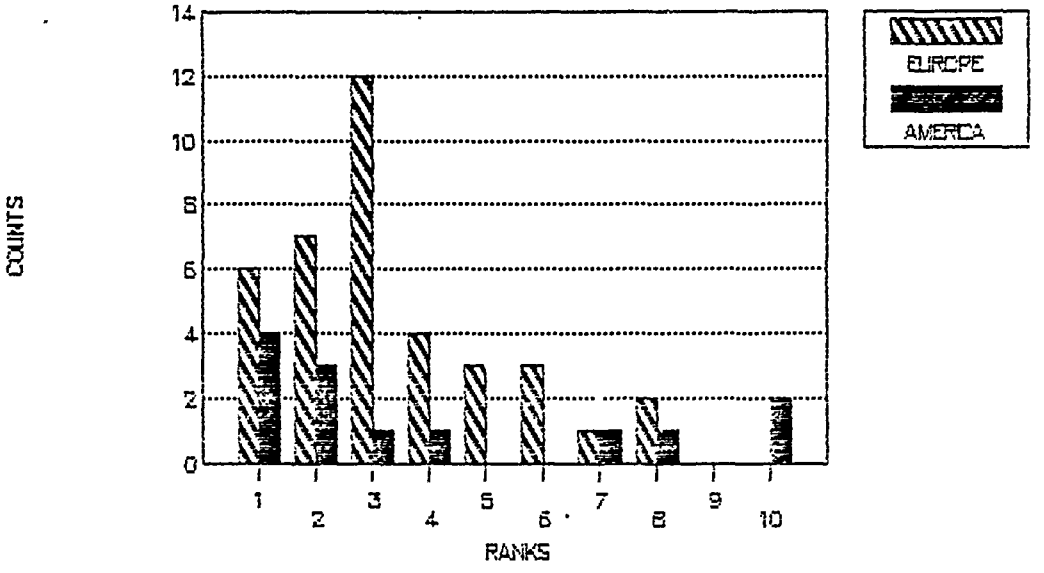
CROSS-SERV. SITUATION RESPONSIBILITY

DEPARTMENTS OF DEFENSE



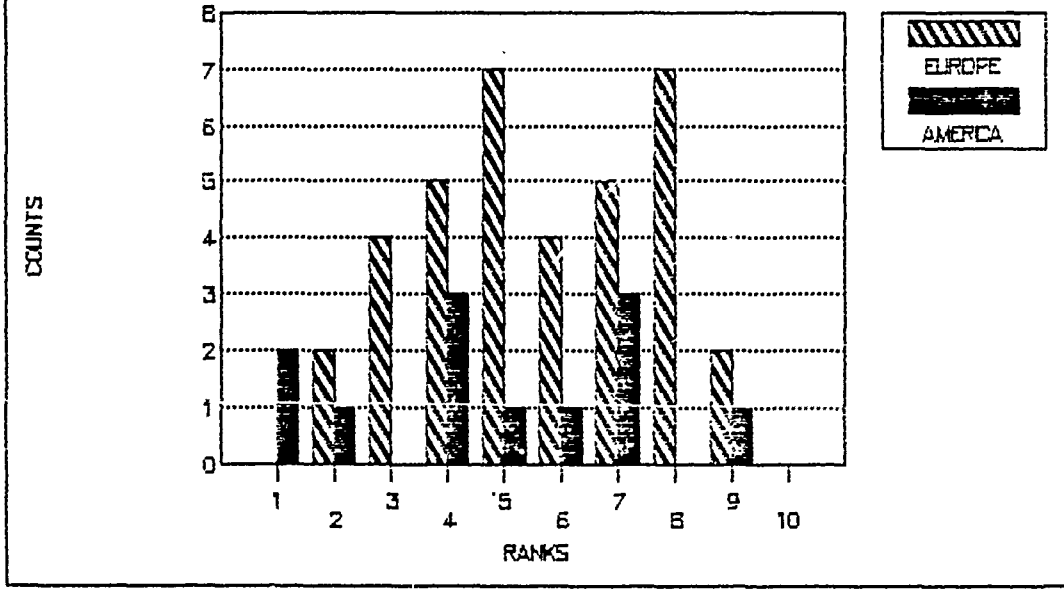
CROSS-SERV. SITUATION RESPONSIBILITY

NATO MILITARY BODIES



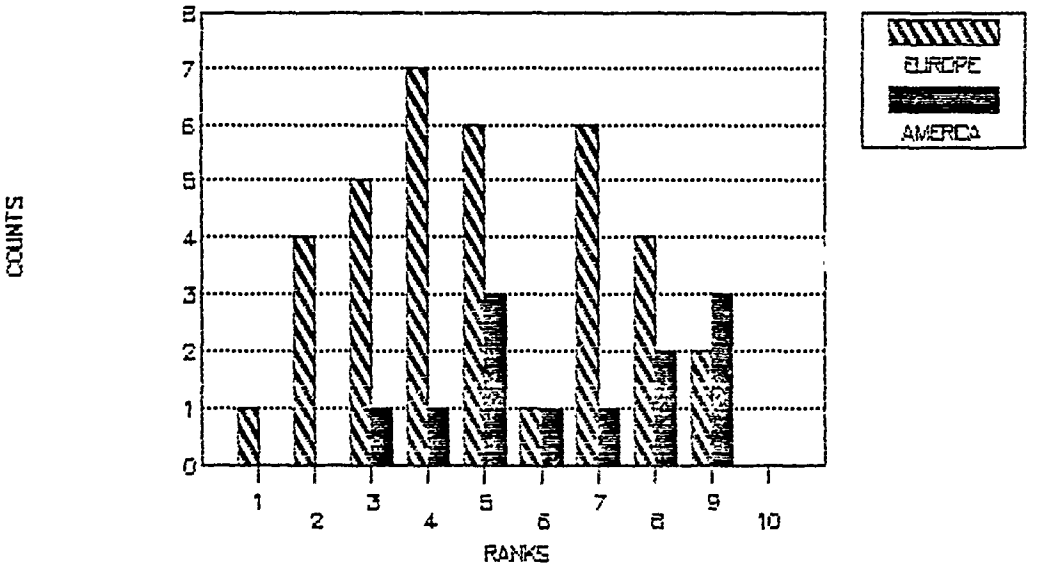
CROSS-SERV. SITUATION RESPONSIBILITY

NATO CIVILIAN BODIES



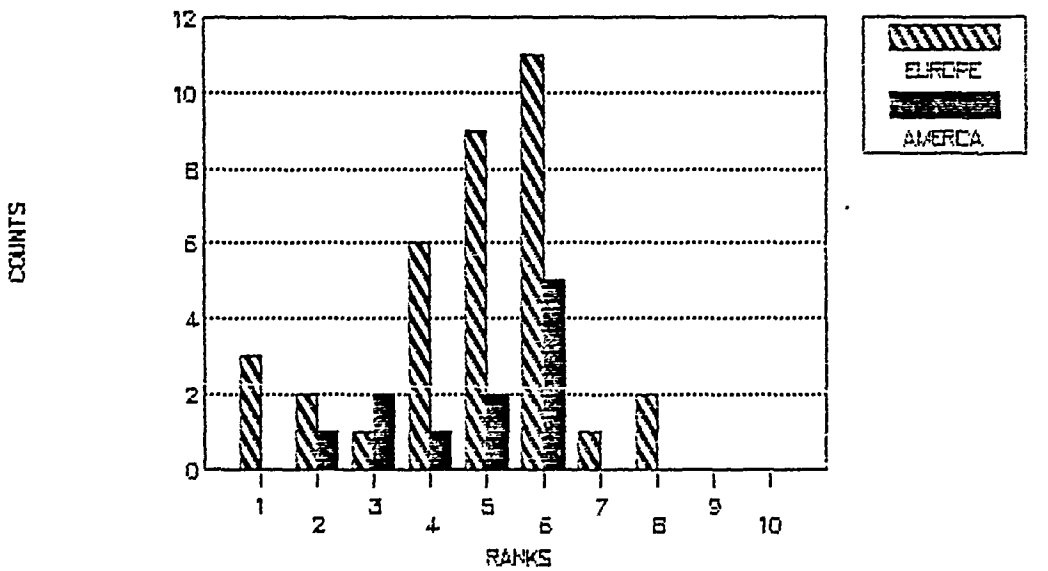
CROSS-SERV. SITUATION RESPONSIBILITY

COOPERATIVE PROGRAMS



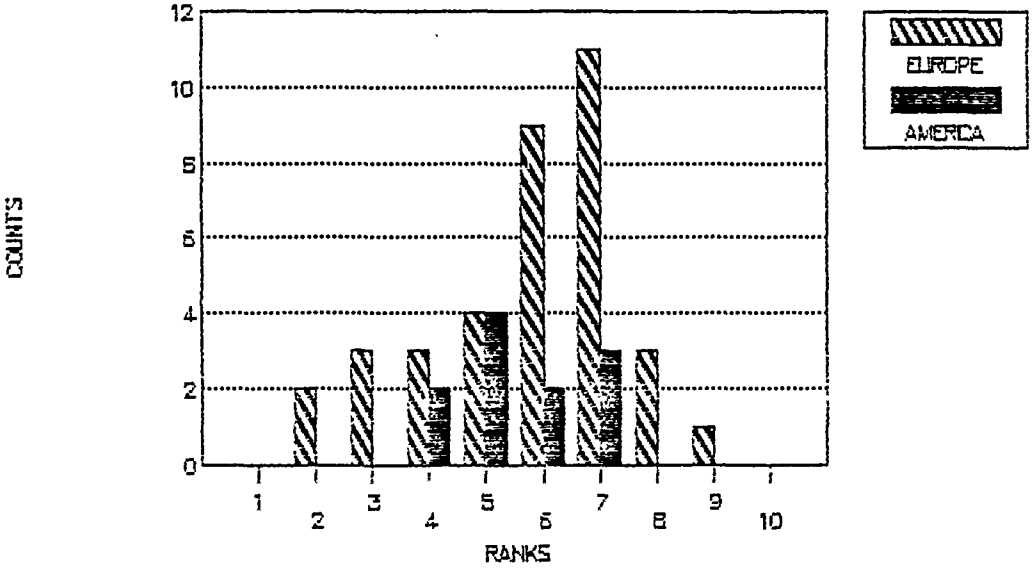
CROSS-SERV. SITUATION RESPONSIBILITY

AIRCRAFT MANUFACTURERS AND ASSEMBLERS



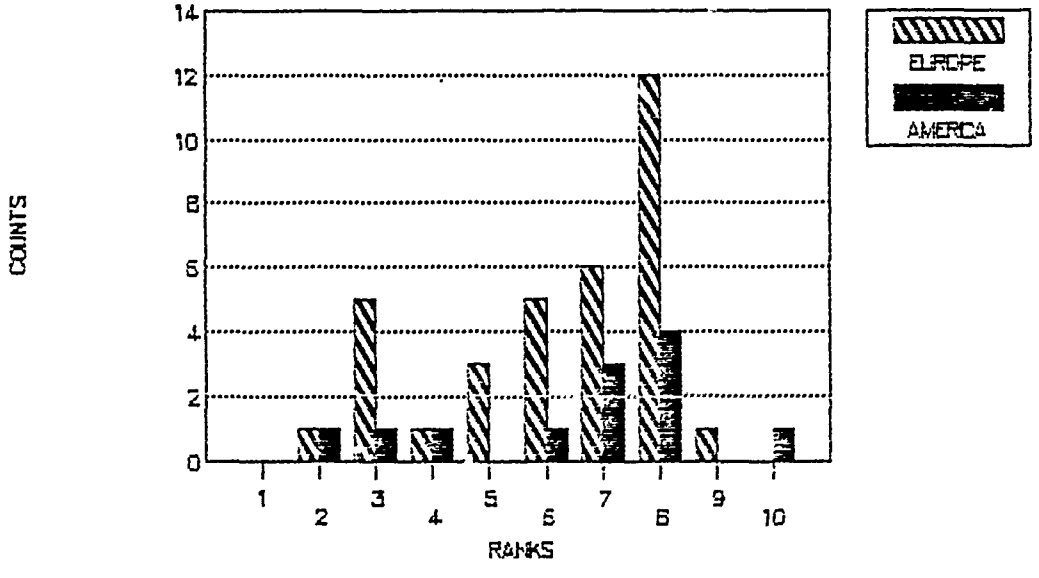
CROSS-SERV. SITUATION RESPONSIBILITY

ENGINE AND ENGINE PART MANUFACTURERS



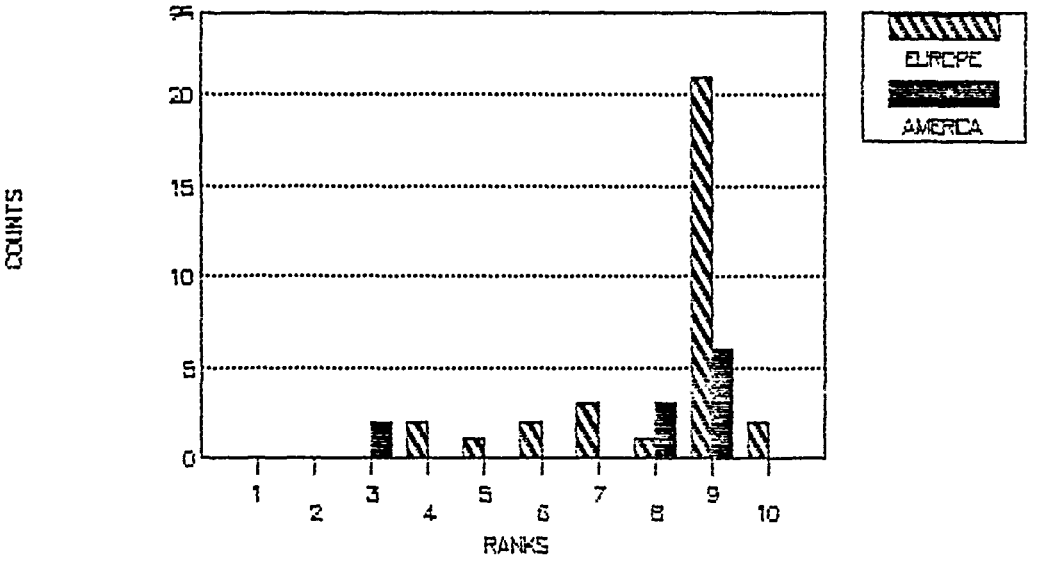
CROSS-SERV. SITUATION RESPONSIBILITY

AIRCRAFT PARTS AND AUXILIARY EQUIPMENT



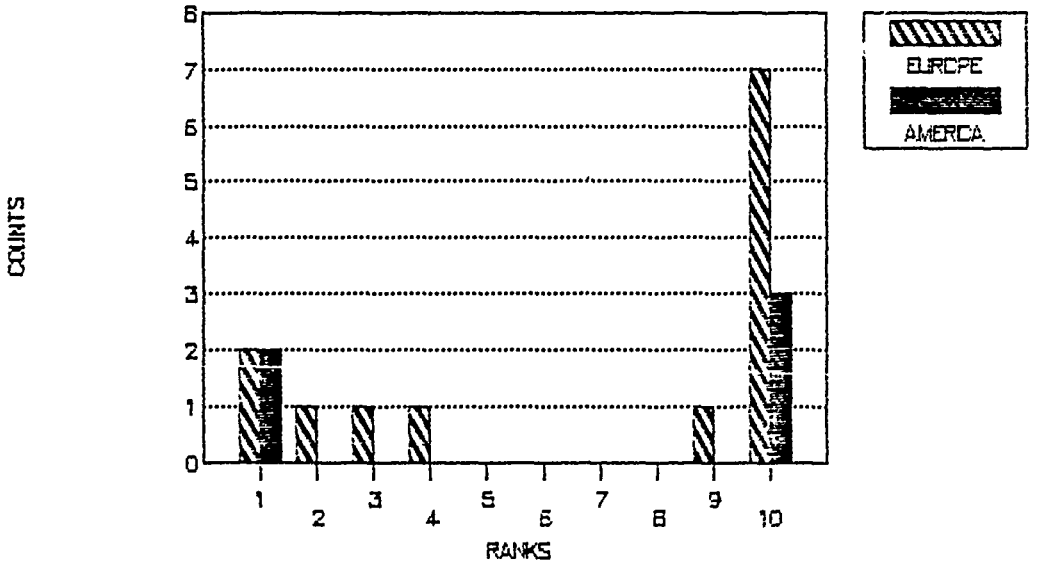
CROSS-SERV. SITUATION RESPONSIBILITY

OTHER RELATED INDUSTRIES



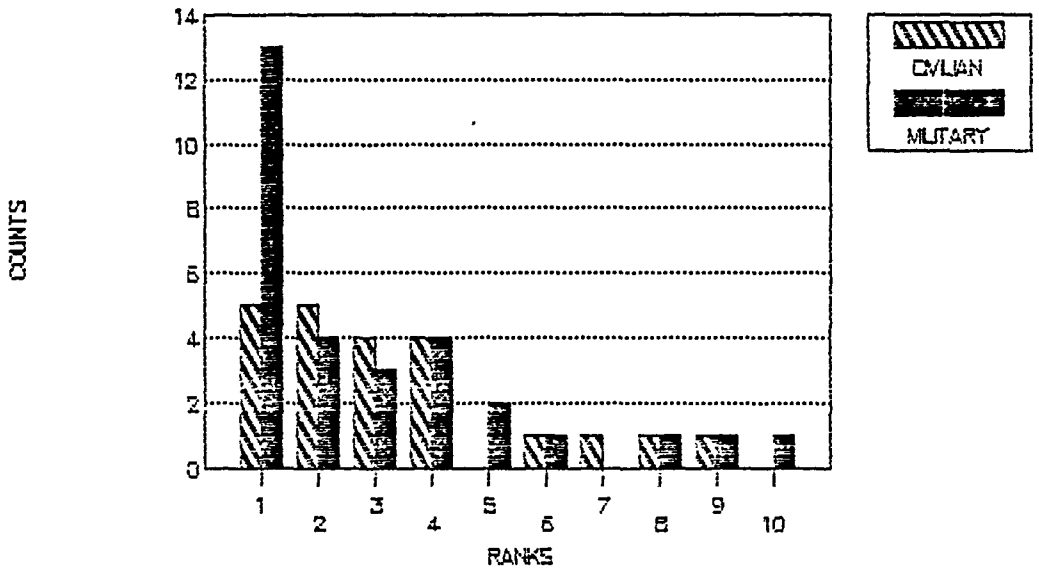
CROSS-SERV. SITUATION RESPONSIBILITY

OTHER



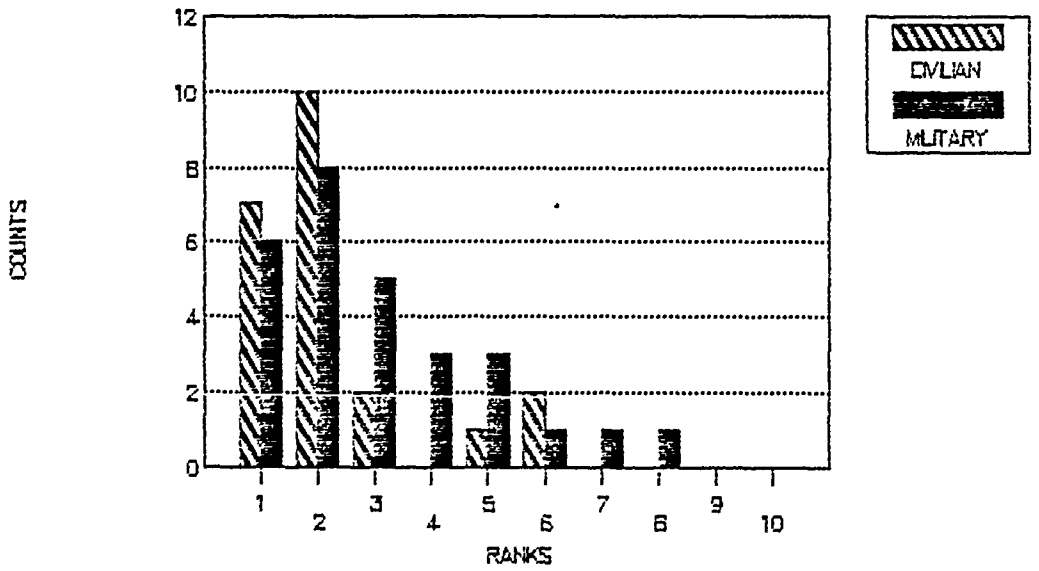
CROSS-SERV. SITUATION RESPONSIBILITY

NATIONAL AIR FORCES



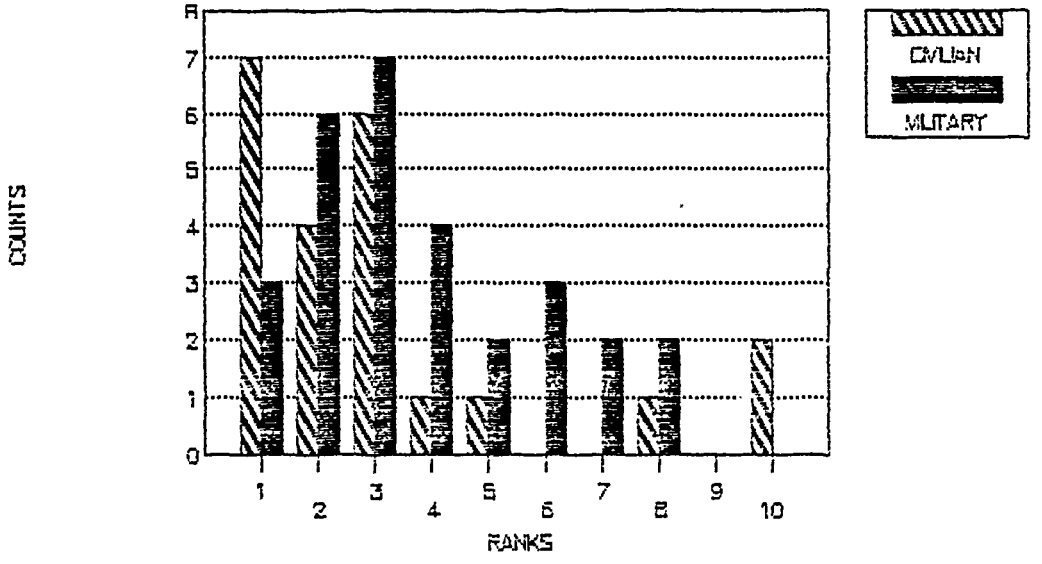
CROSS-SERV. SITUATION RESPONSIBILITY

DEPARTMENTS OF DEFENSE



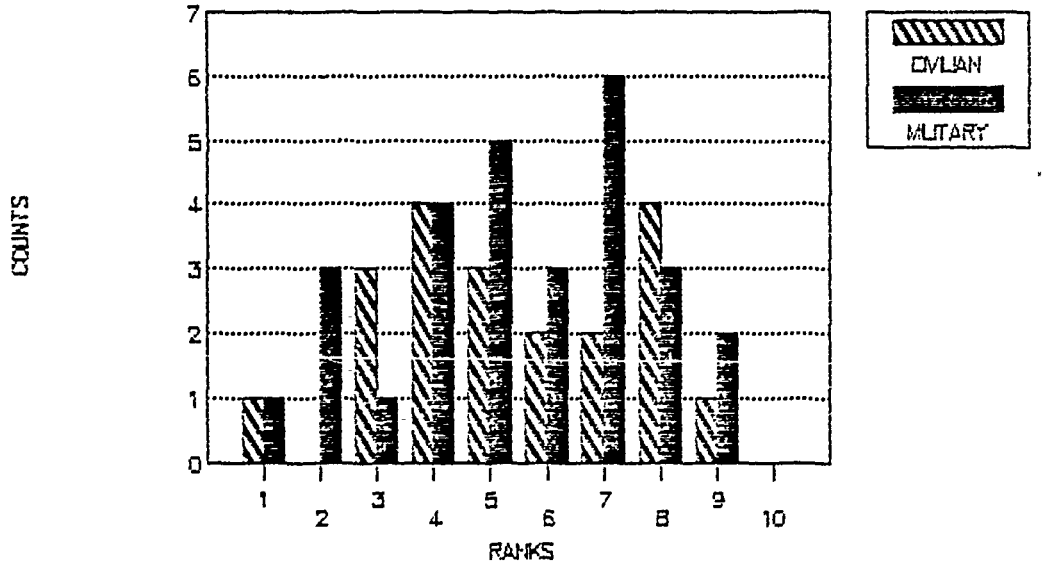
CROSS-SERV. SITUATION RESPONSIBILITY

NATO MILITARY BODIES



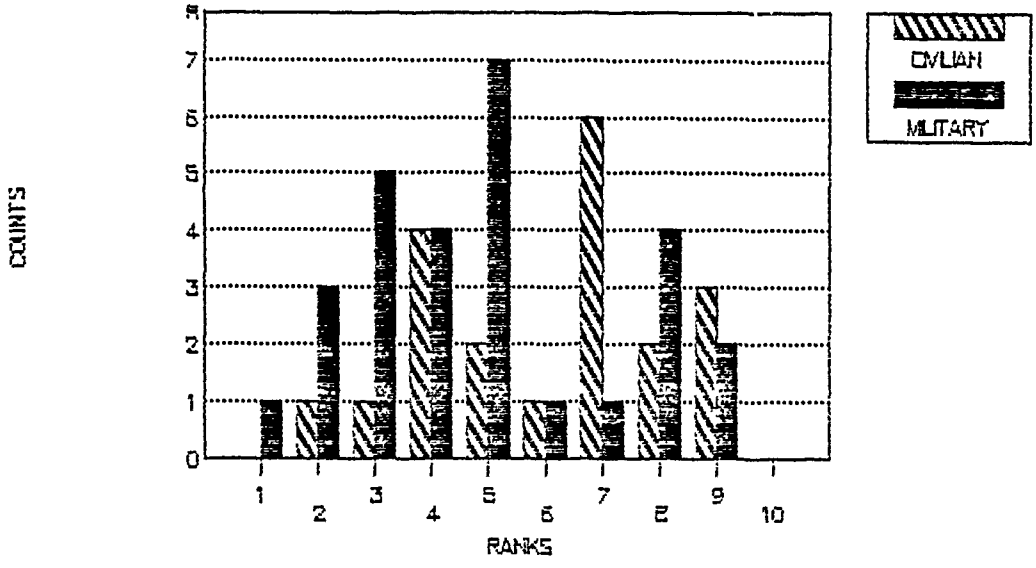
CROSS-SERV. SITUATION RESPONSIBILITY

NATO CIVILIAN BODIES



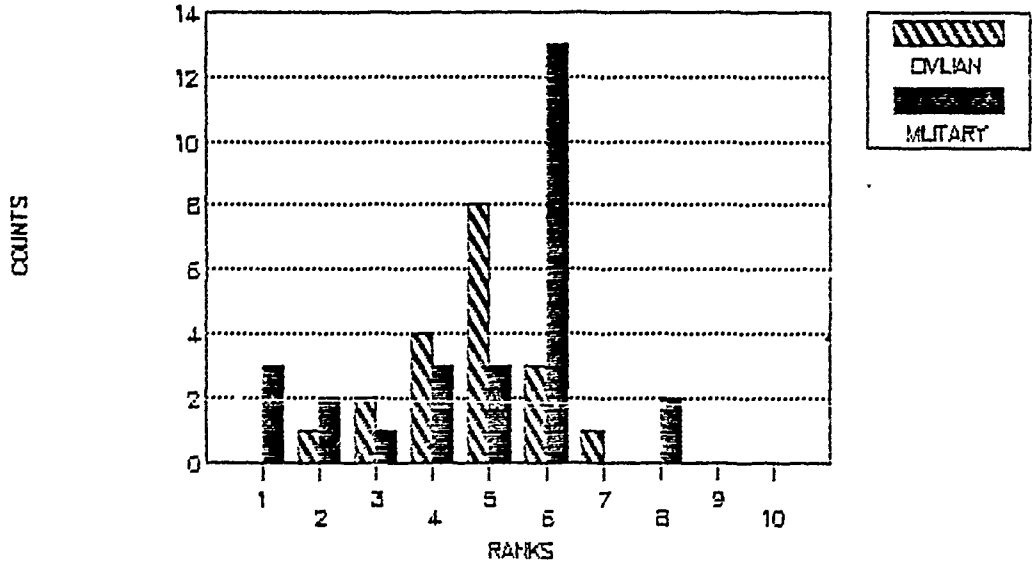
CROSS-SERV. SITUATION RESPONSIBILITY

COOPERATIVE PROGRAMS



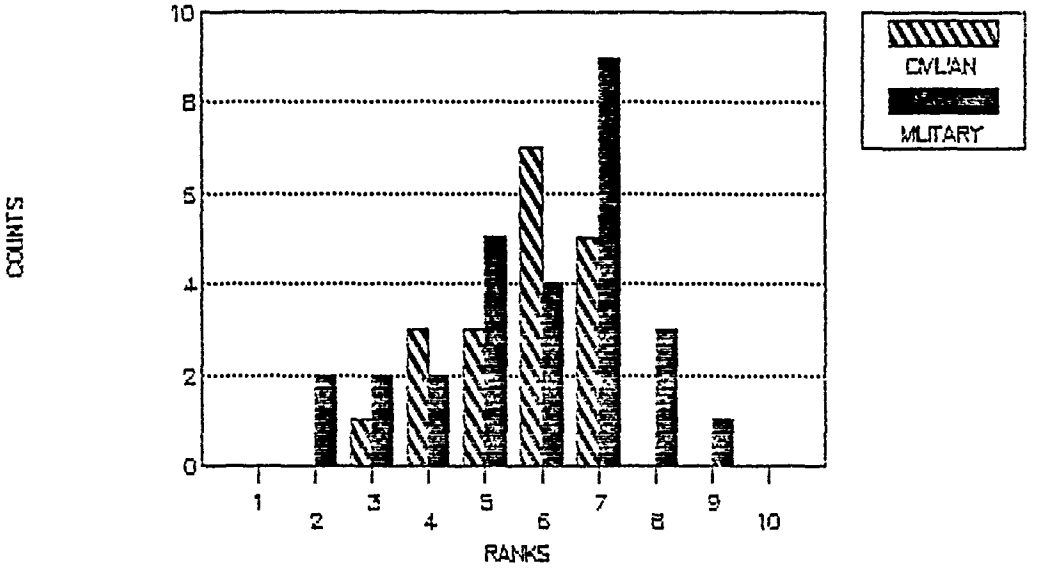
CROSS-SERV. SITUATION RESPONSIBILITY

AIRCRAFT MANUFACTURERS AND ASSEMBLERS



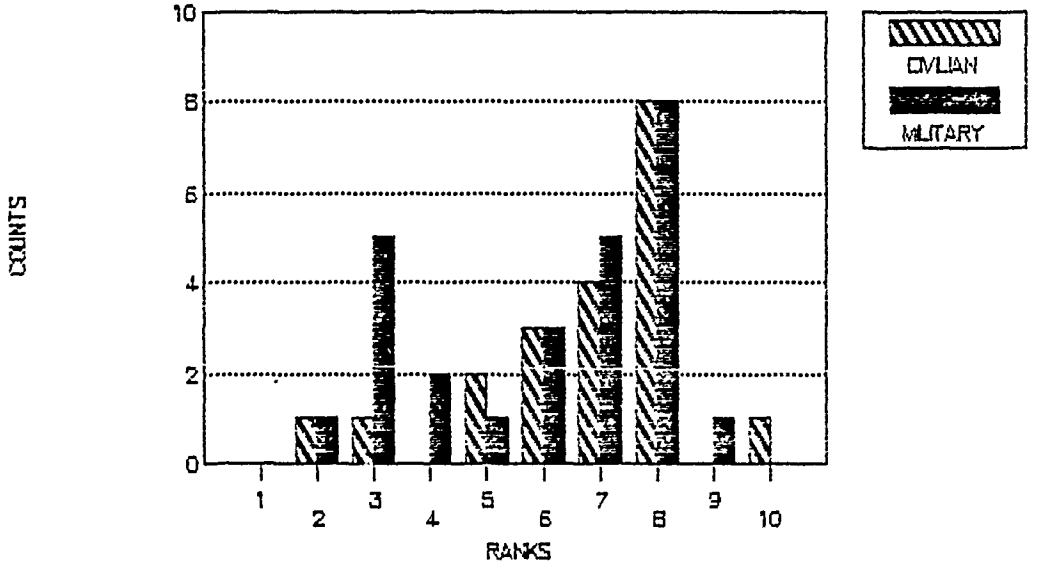
CROSS-SERV. SITUATION RESPONSIBILITY

ENGINE AND ENGINE PART MANUFACTURERS



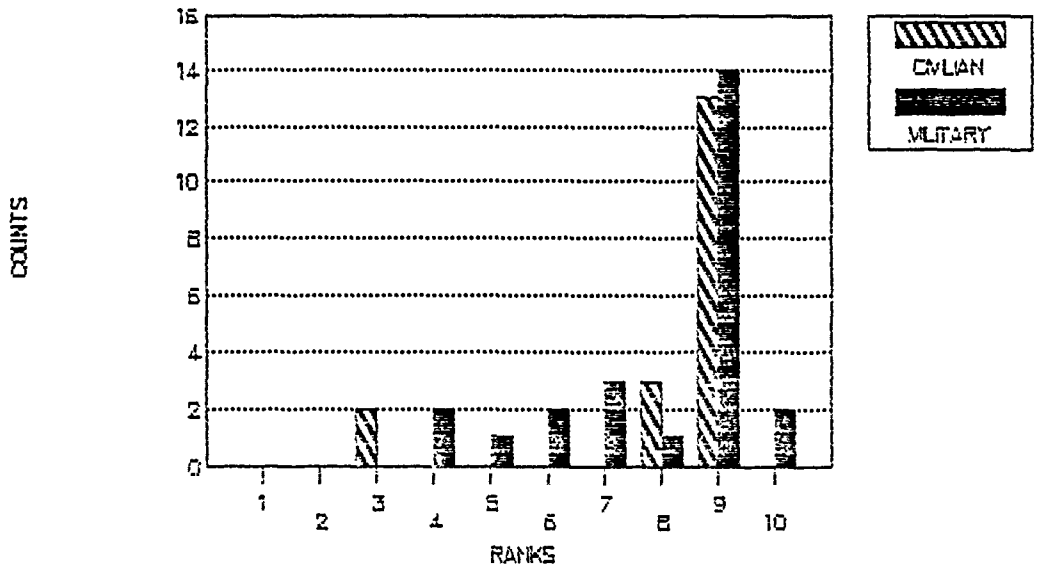
CROSS-SERV. SITUATION RESPONSIBILITY

AIRCRAFT PARTS AND AUXILIARY EQUIPMENT



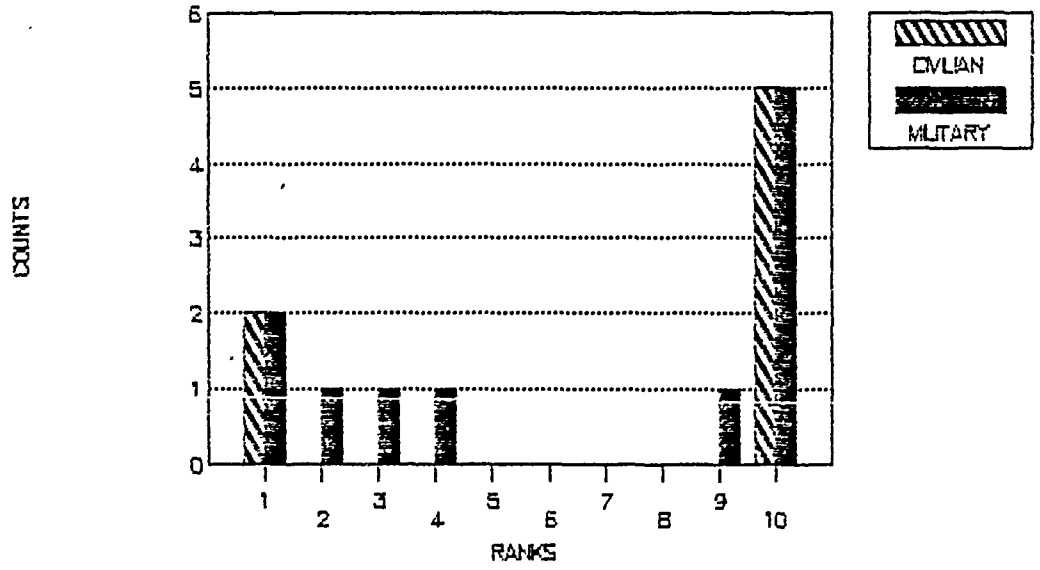
CROSS-SERV. SITUATION RESPONSIBILITY

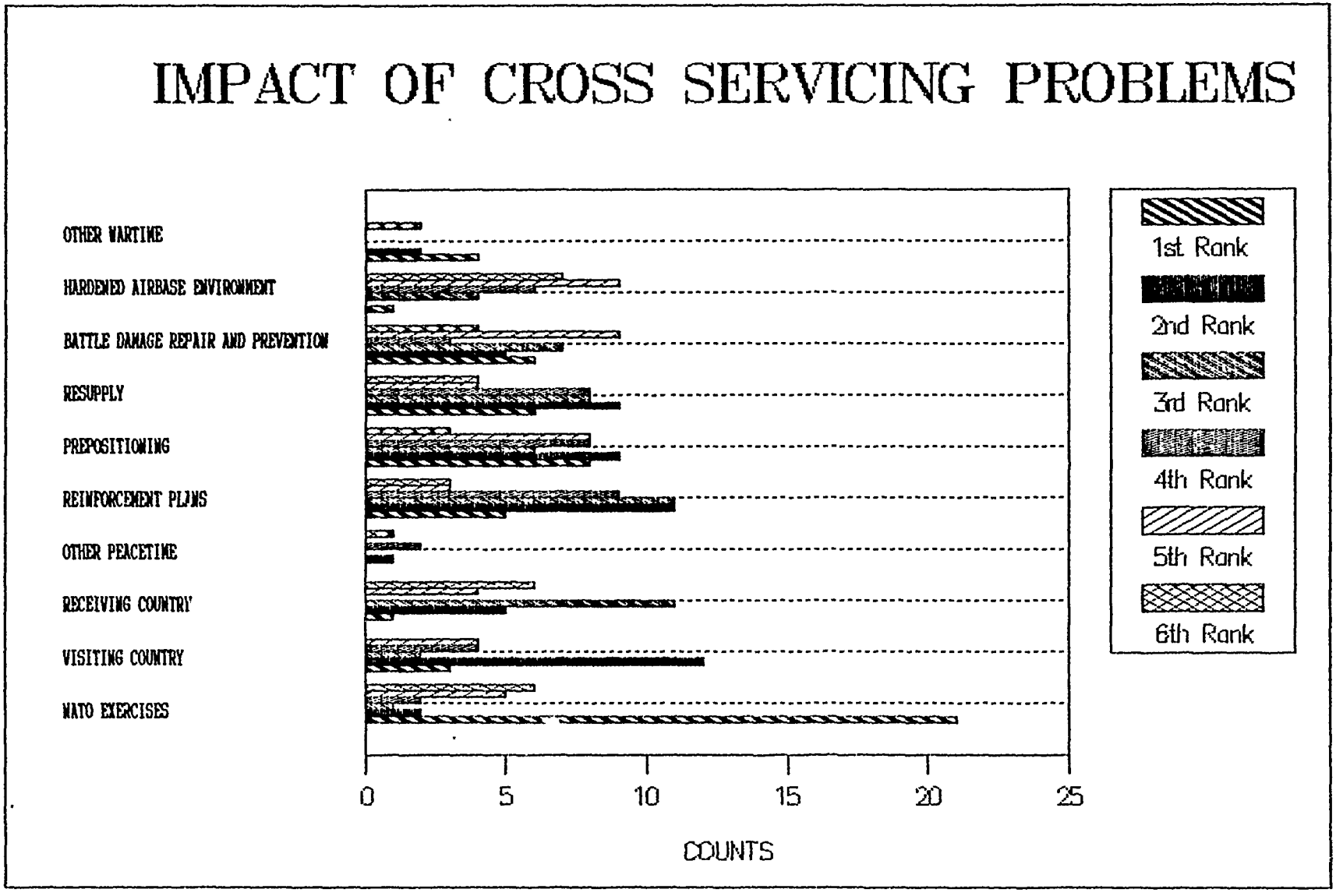
OTHER RELATED INDUSTRIES



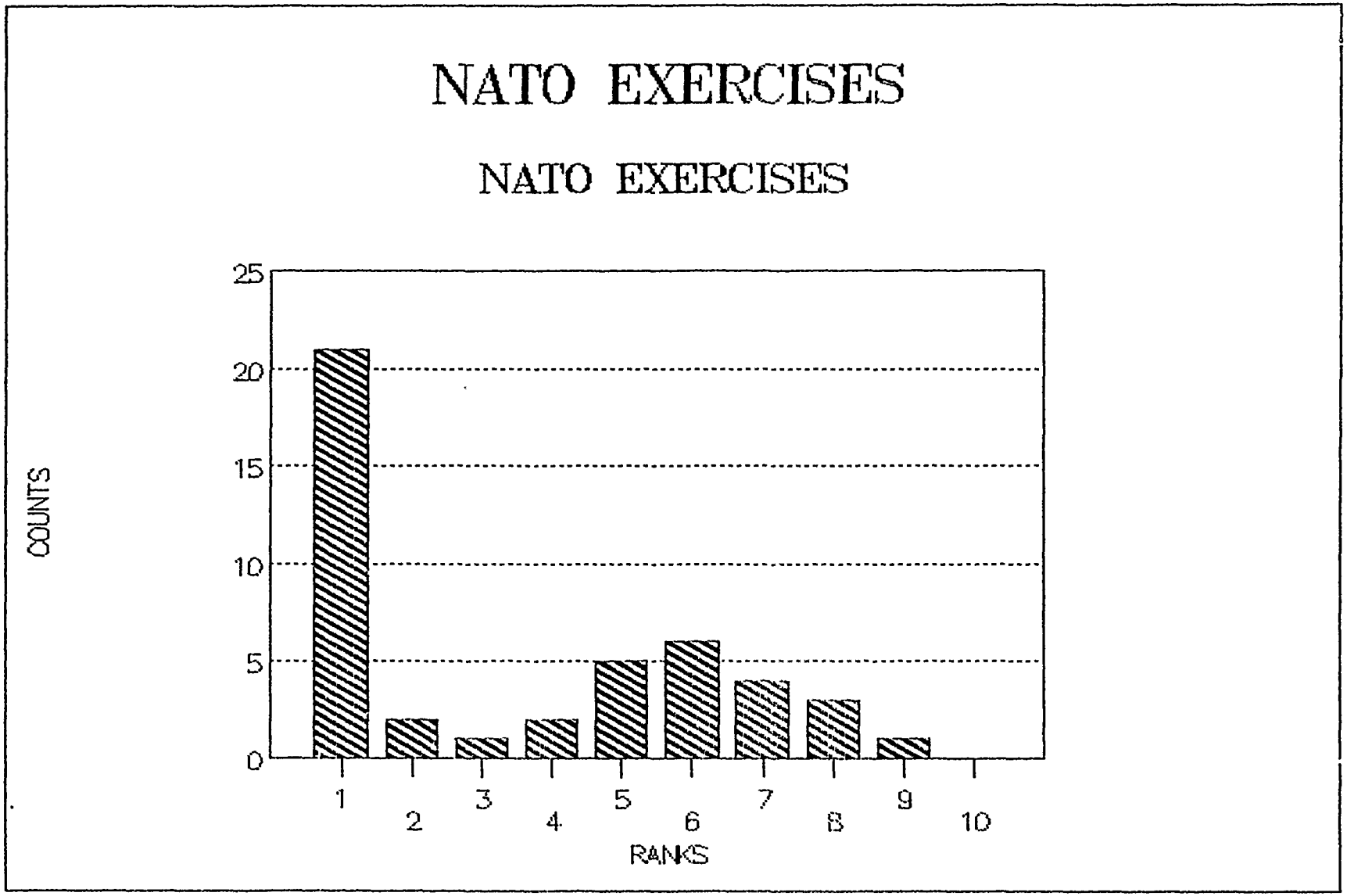
CROSS-SERV. SITUATION RESPONSIBILITY

OTHER



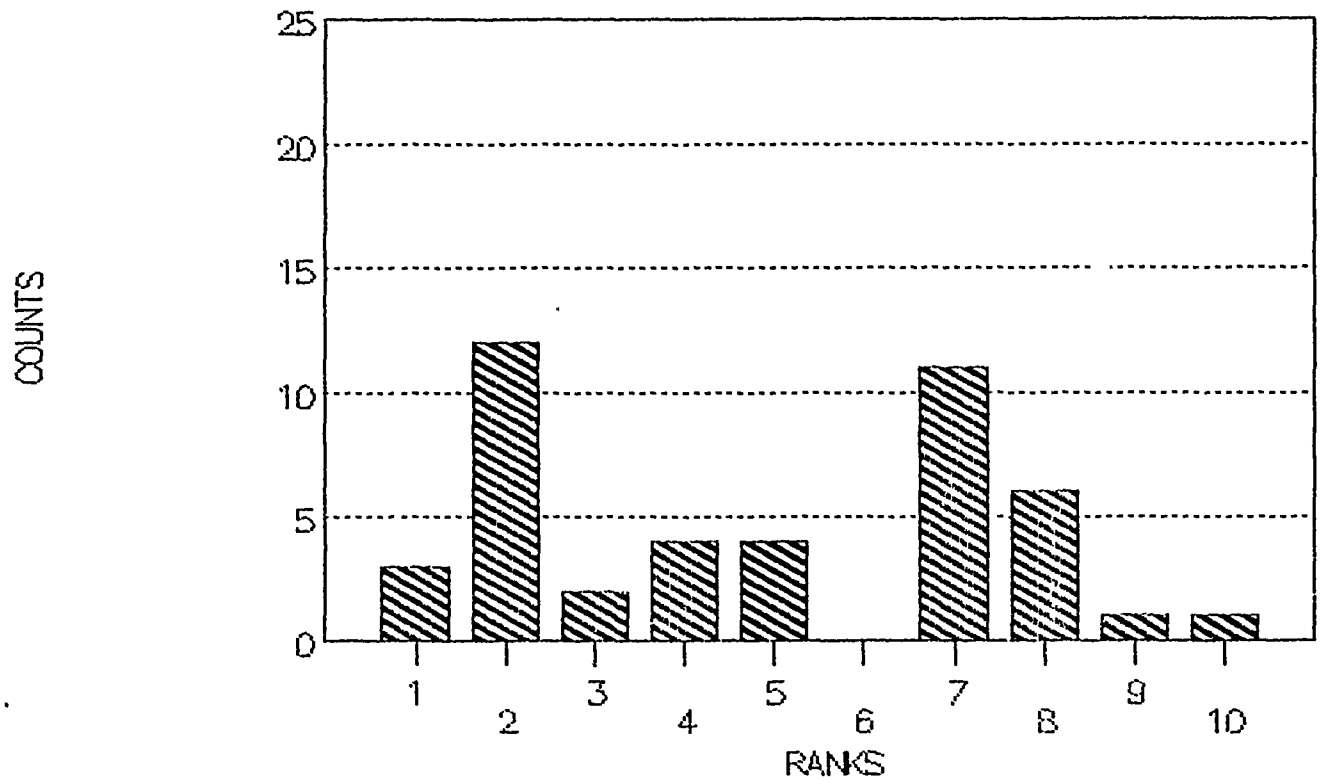

IMPACT OF CROSS SERVICING PROBLEMS
OTHER WARTIME
HARDENED AIRBASE ENVIRONMENT
BATTLE DAMAGE REPAIR AND PREVENTION
RESUPPLY
PREPOSITIONING
REINFORCEMENT PLANS
OTHER PEACETIME
RECEIVING COUNTRY
VISITING COUNTRY
NATO EXERCISES
0
5
10
15
20
25
COUNTS
1st Rank
2nd Rank
3rd Rank
4th Rank
5th Rank
6th Rank

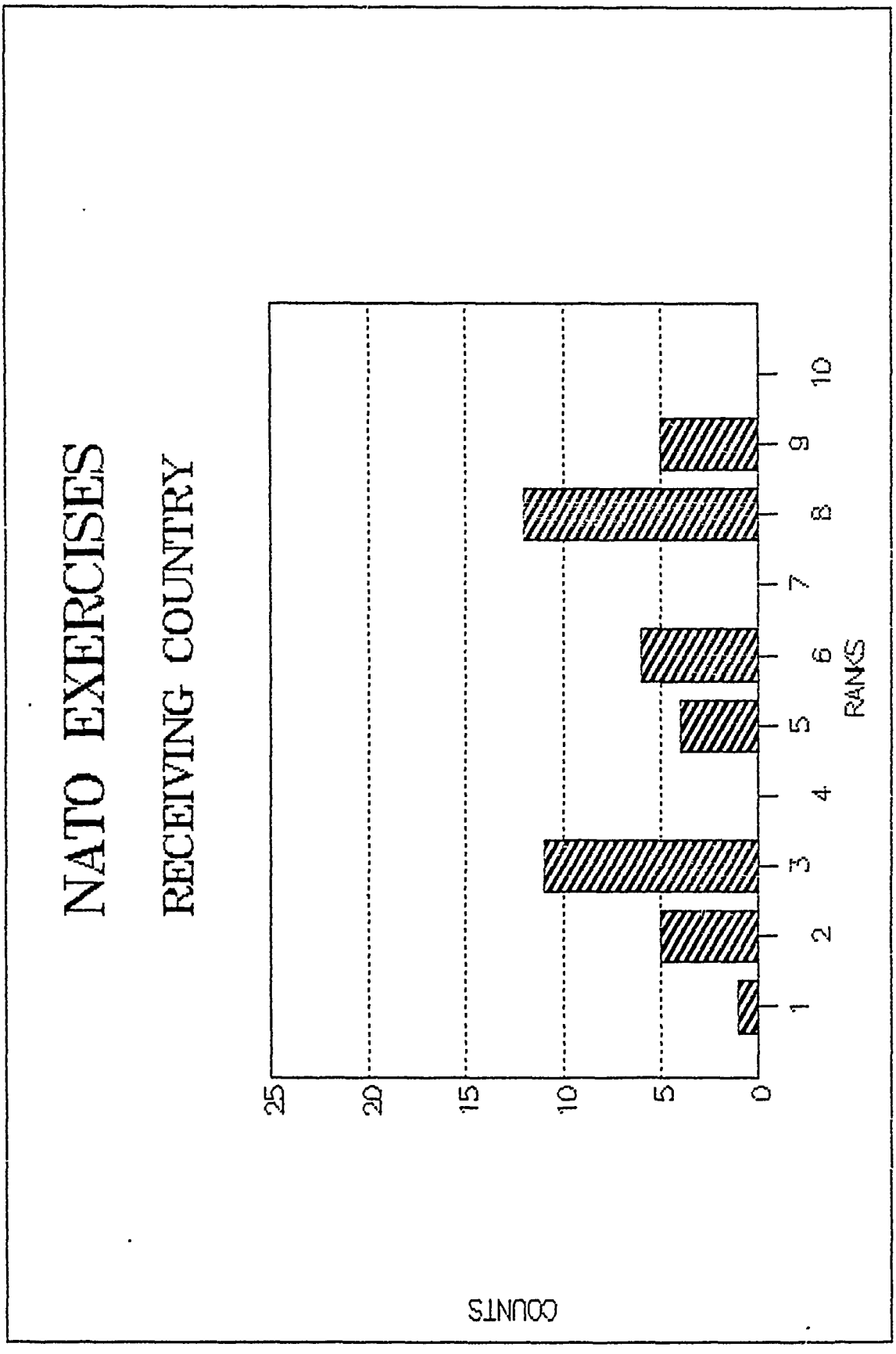
NATO EXERCISES



IMPACT OF CROSS SERVICING PROBLEMS

VISITING COUNTRY




NATO EXERCISES
RECEIVING COUNTRY
COUNTS
25
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15
10
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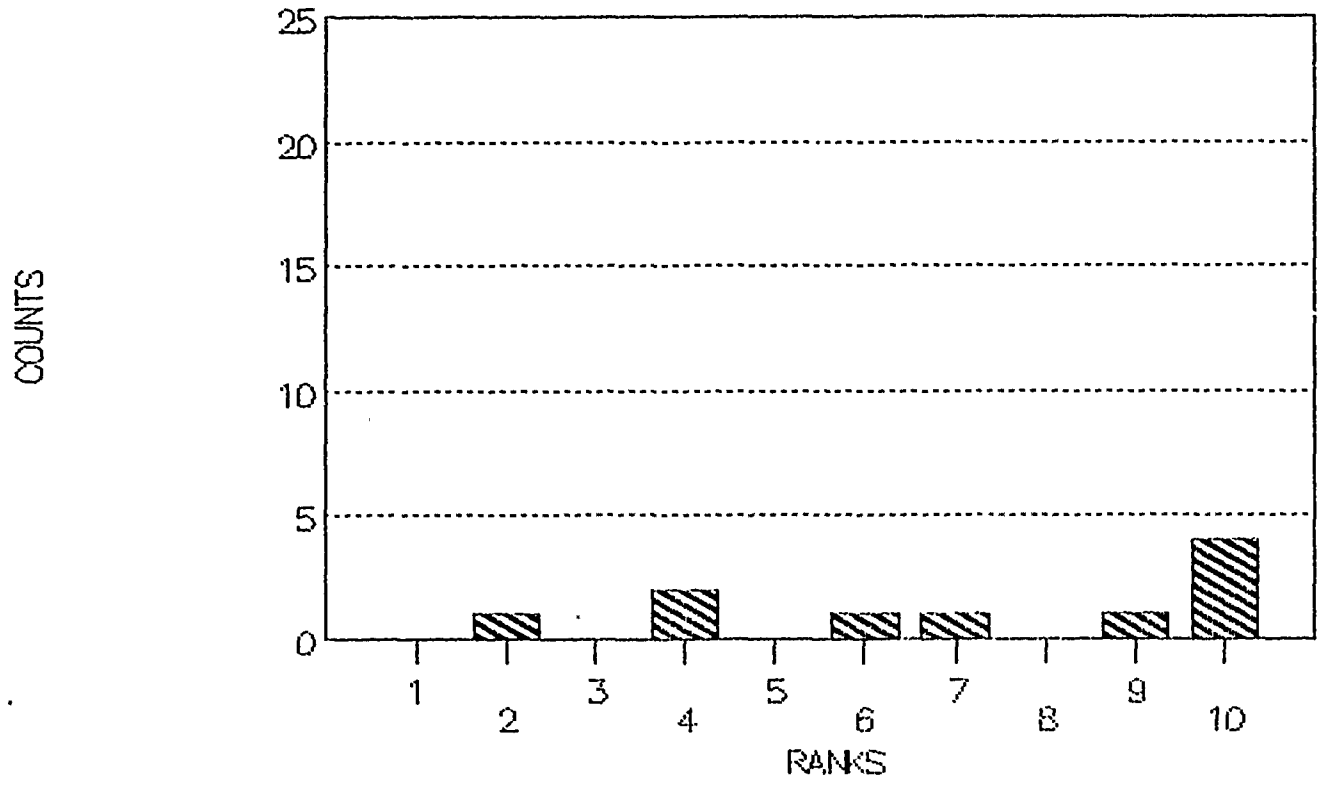
8
9
10
RANKS

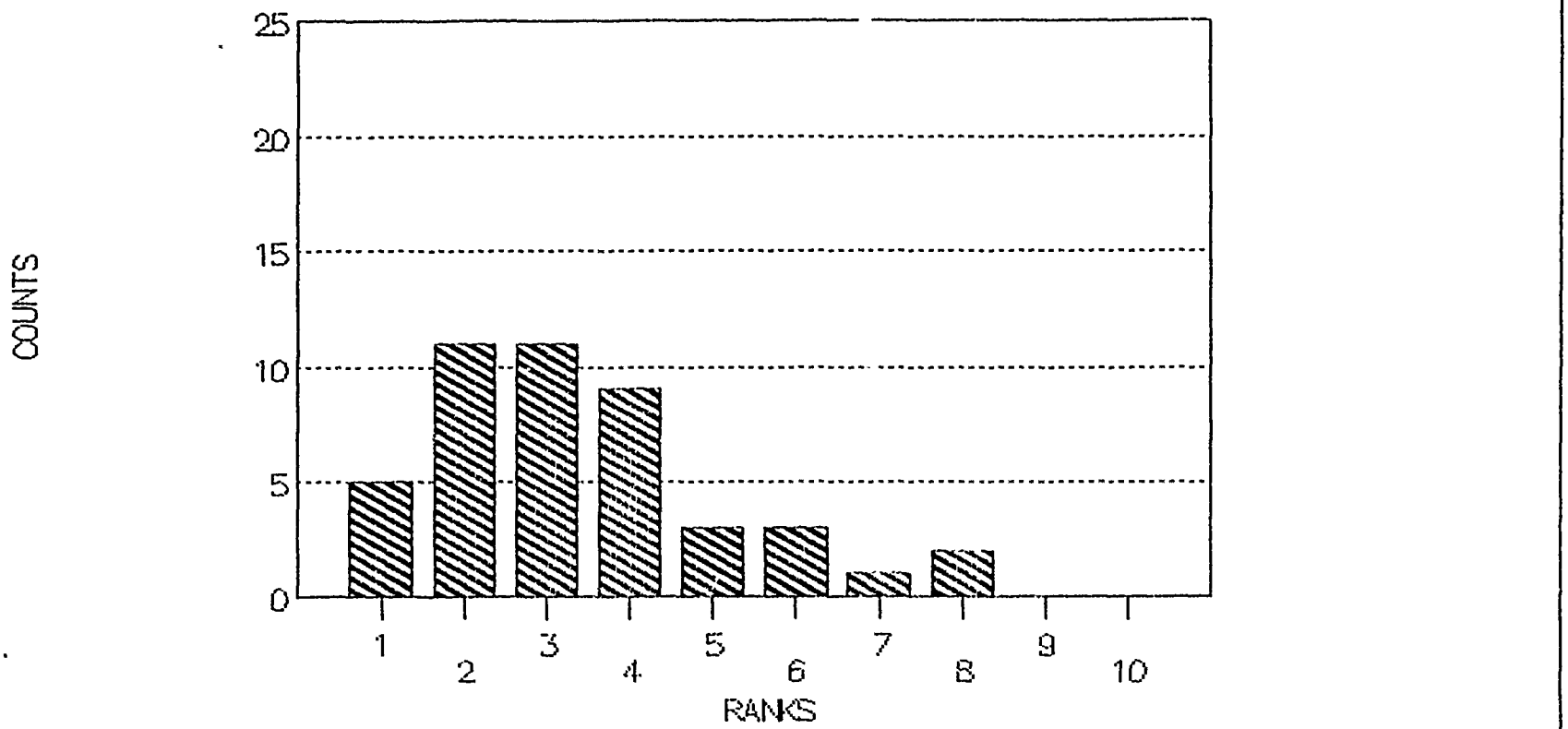
IMPACT OF CROSS SERVICING PROBLEMS

OTHER PEACETIME



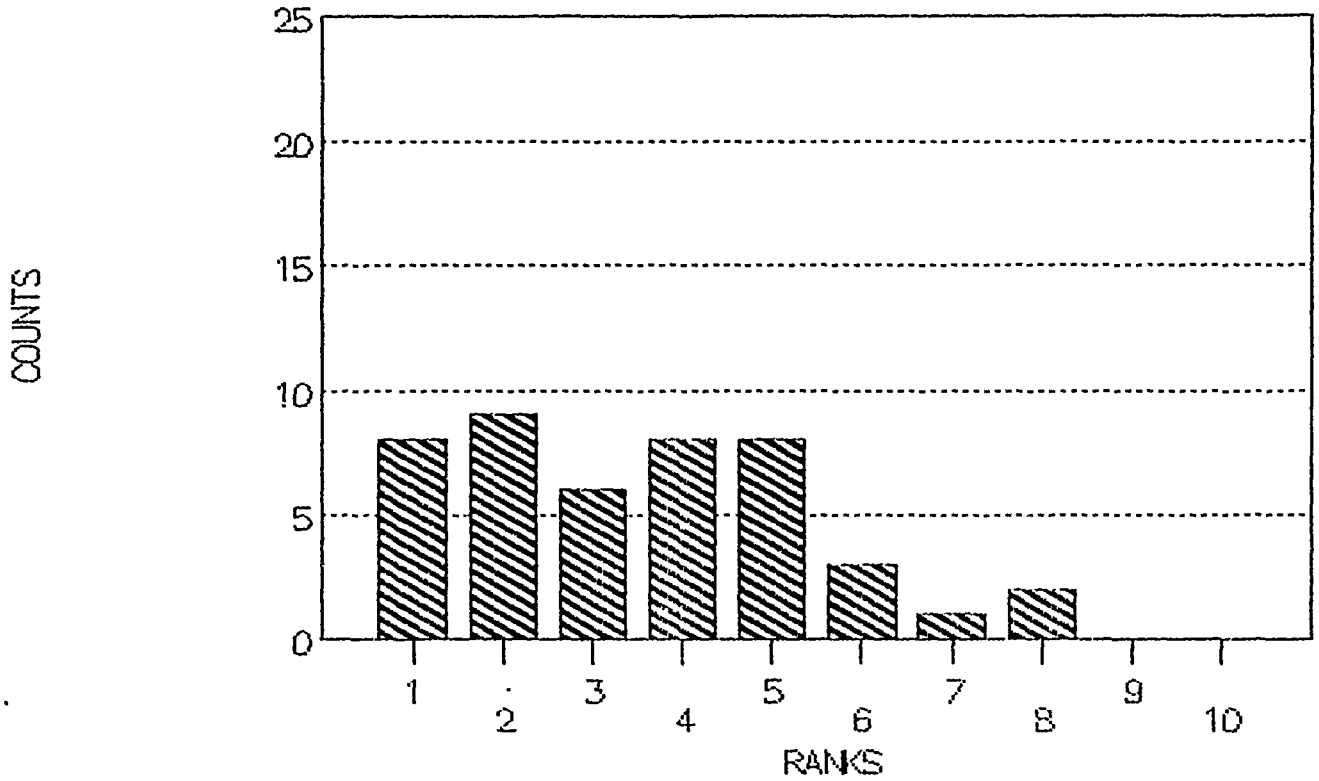
IMPACT OF CROSS SERVICING PROBLEMS

REINFORCEMENT PLANS



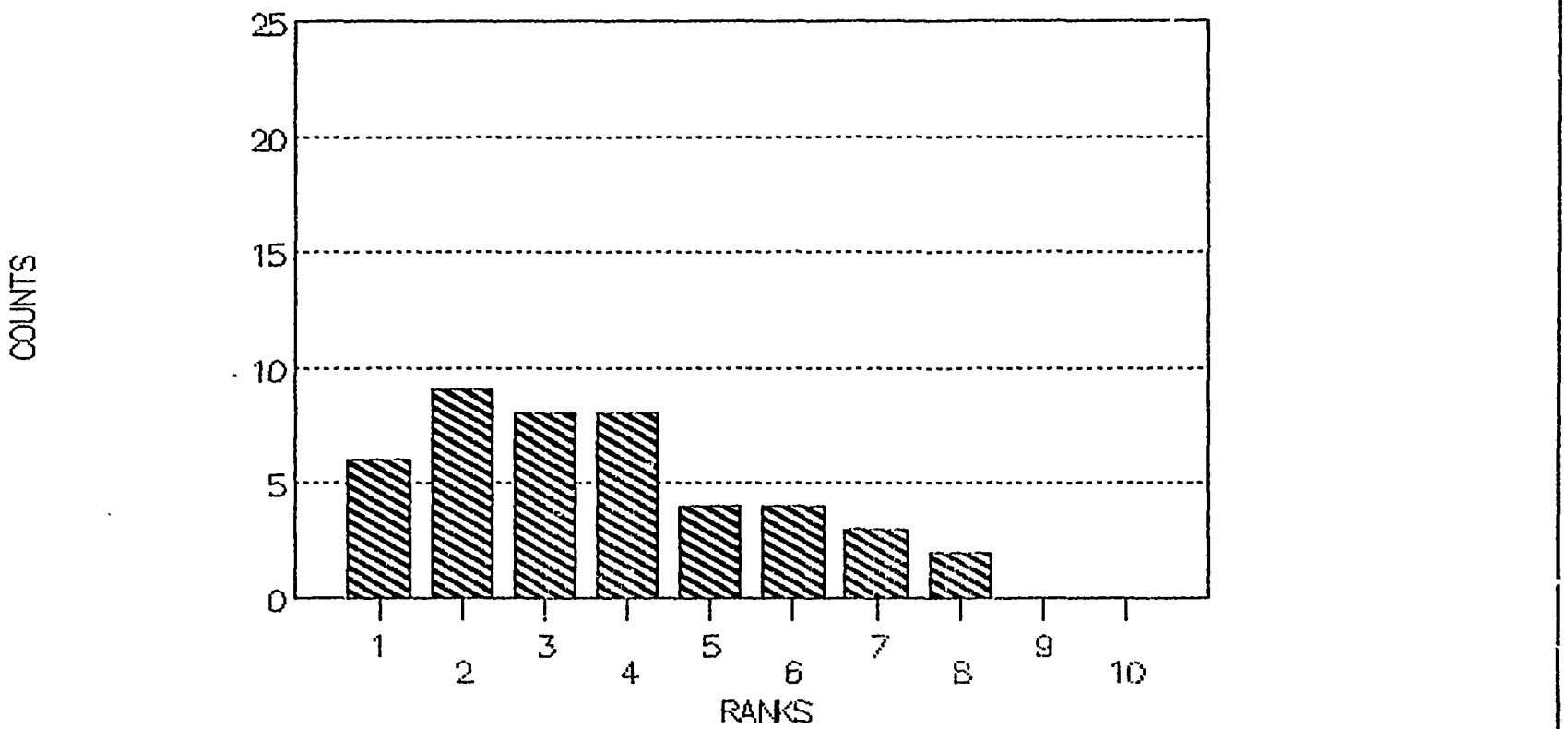
IMPACT OF CROSS SERVICING PROBLEMS

PREPOSITIONING



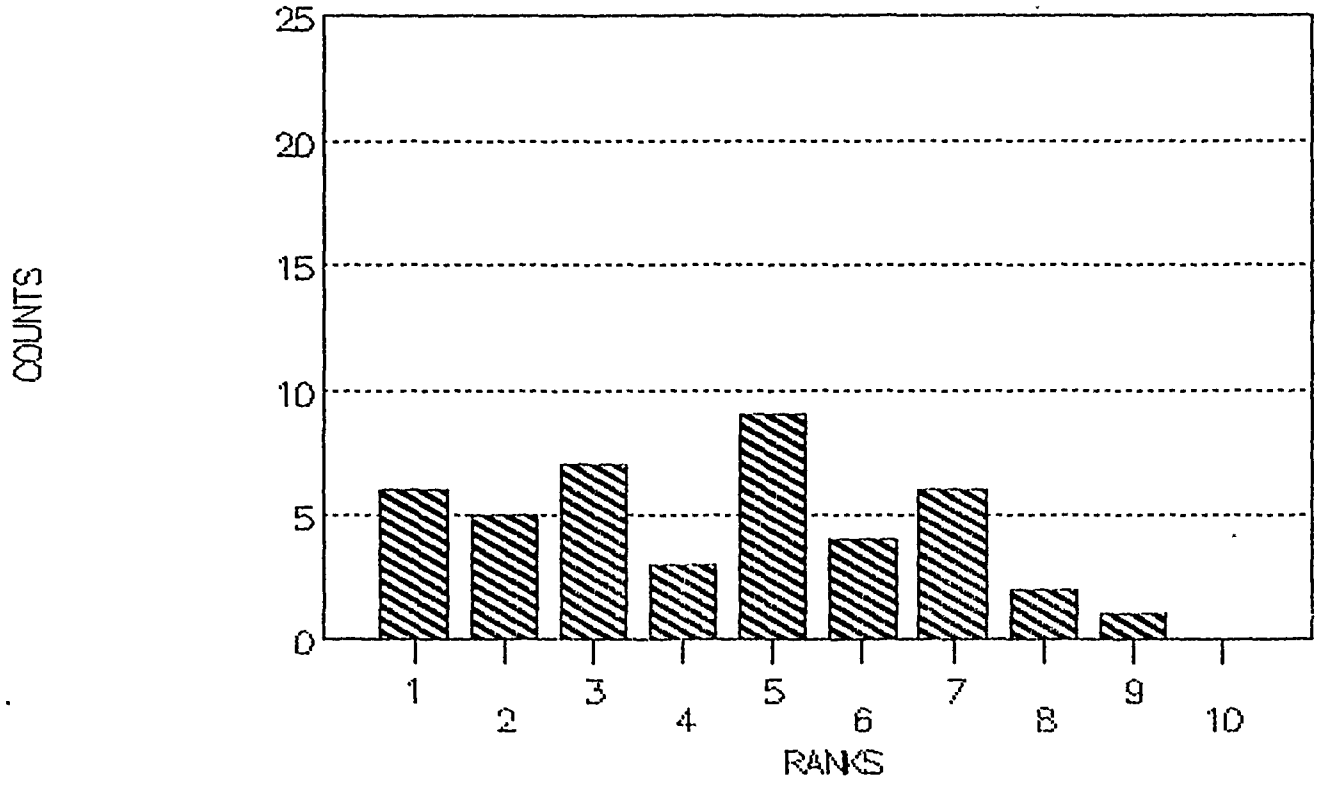
IMPACT OF CROSS SERVICING PROBLEMS

RESUPPLY



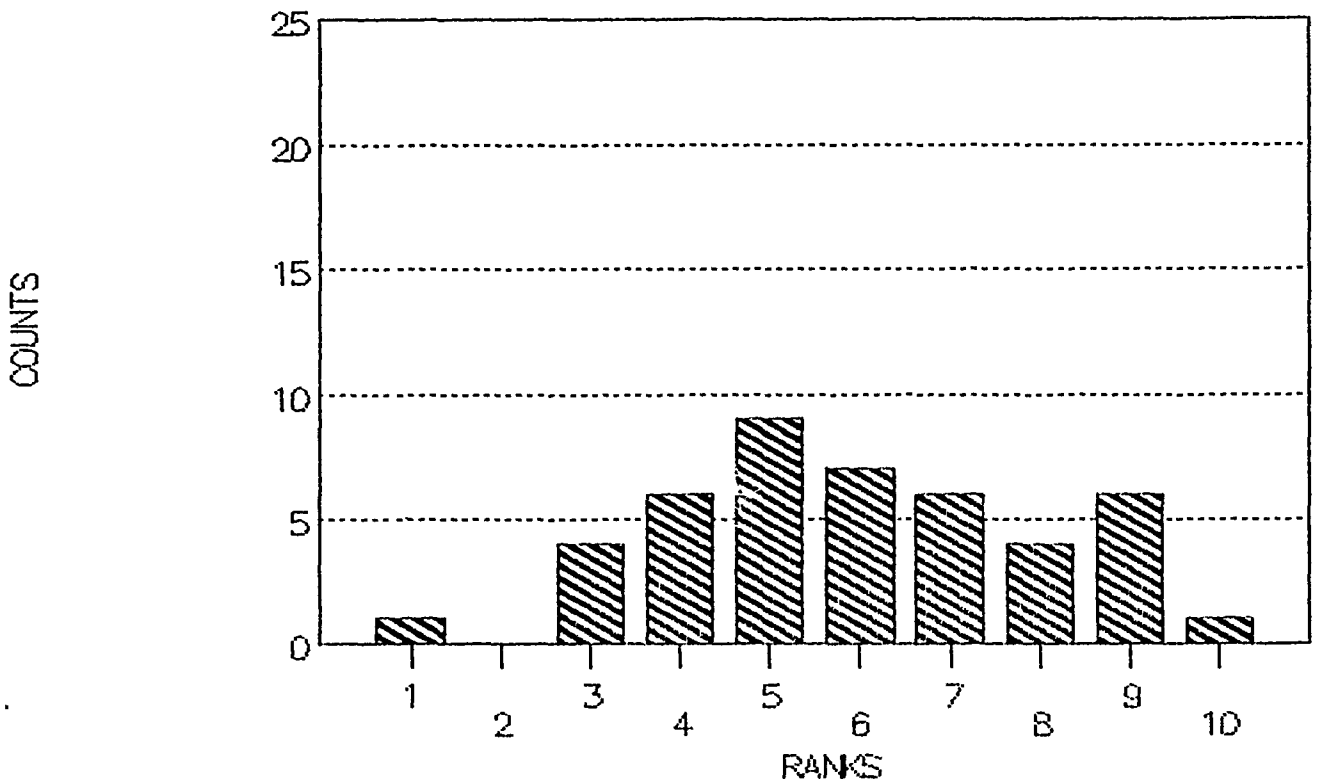
IMPACT OF CROSS SERVICING PROBLEMS

BATTLE DAMAGE REPAIR AND PREVENTION



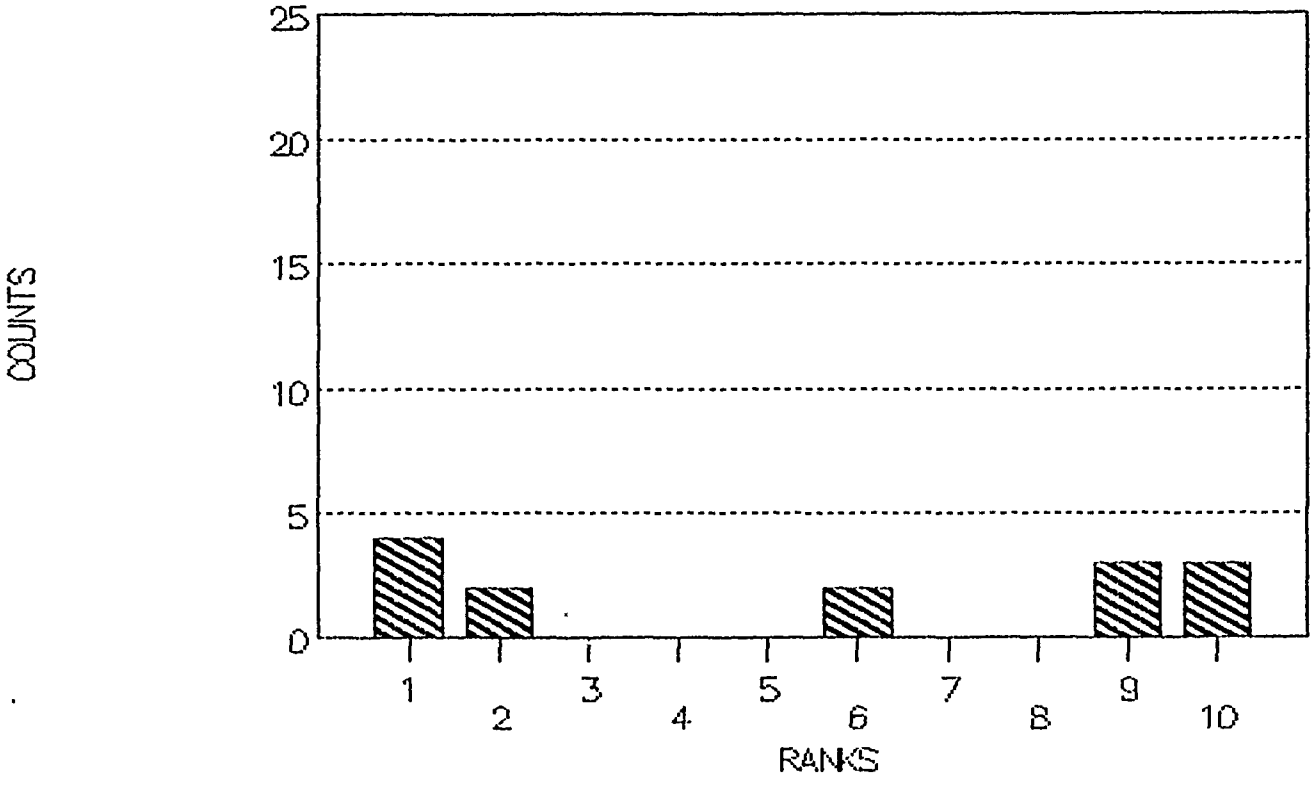
IMPACT OF CROSS SERVICING PROBLEMS

HARDENED AIRBASE ENVIRONMENT



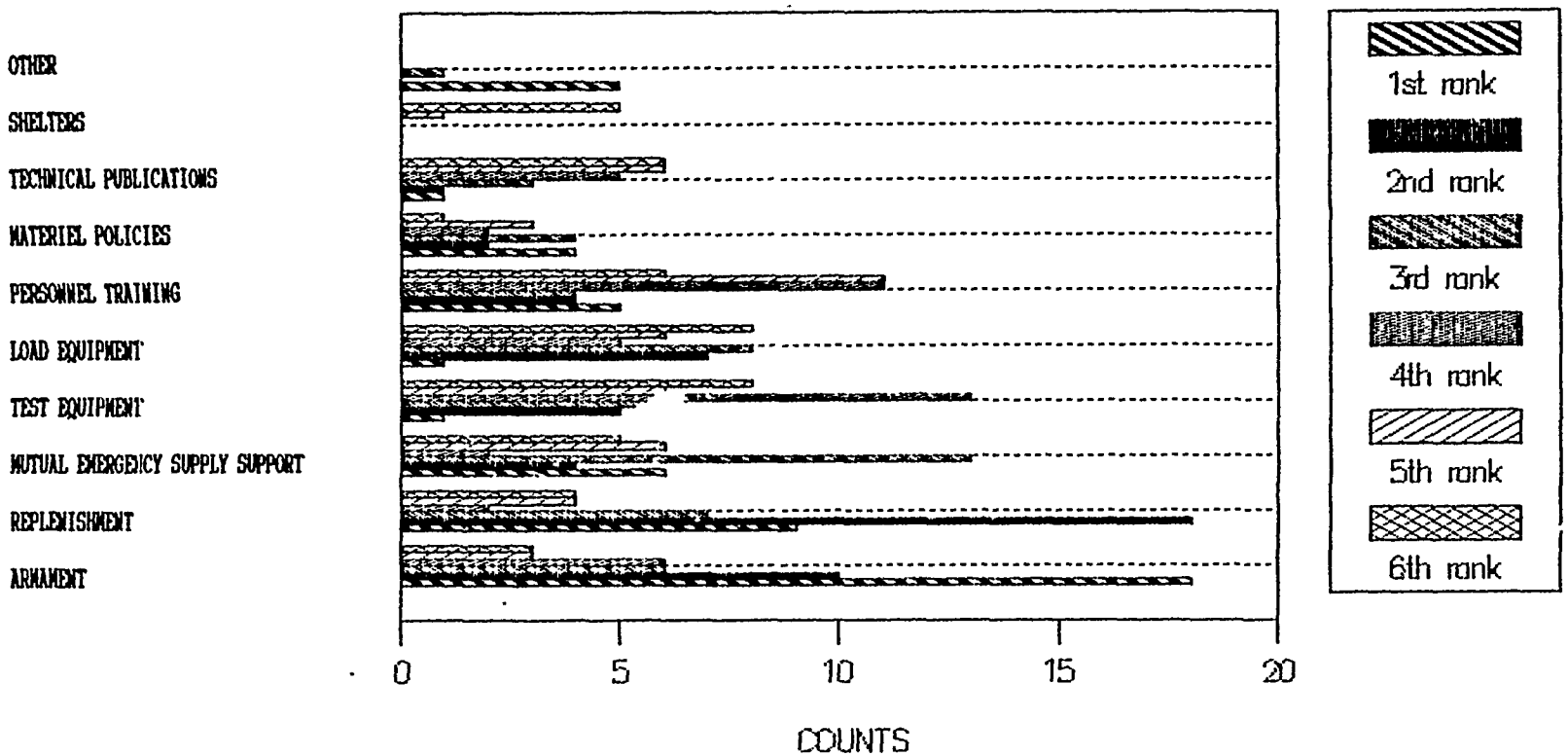
IMPACT OF CROSS SERVICING PROBLEMS

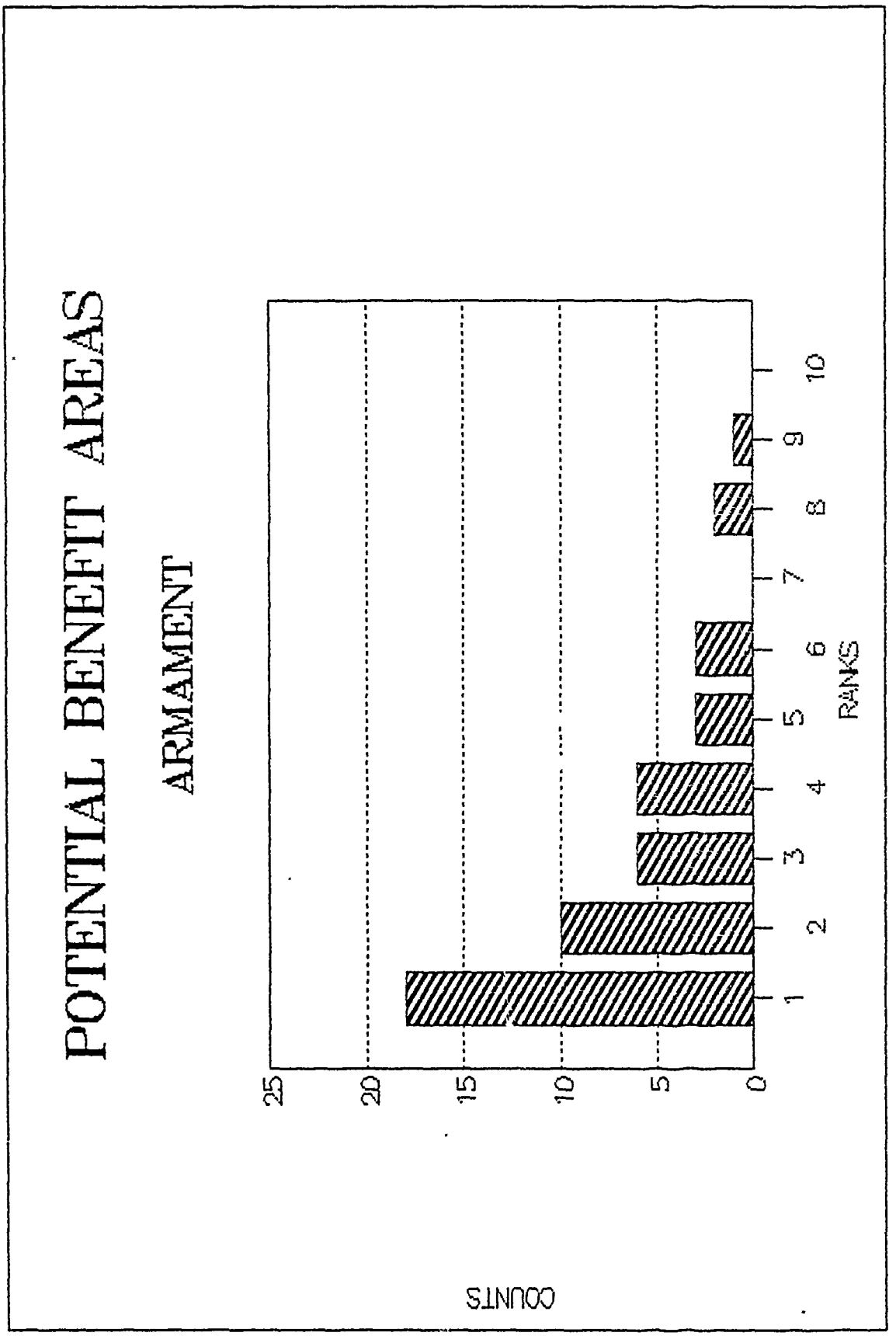
OTHER WARTIME



IMPACT OF CROSS SERVICING PROBLEMS

POTENTIAL BENEFIT AREAS




POTENTIAL BENEFIT AREAS
ARMAMENT
COUNTS
25
20
15
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0
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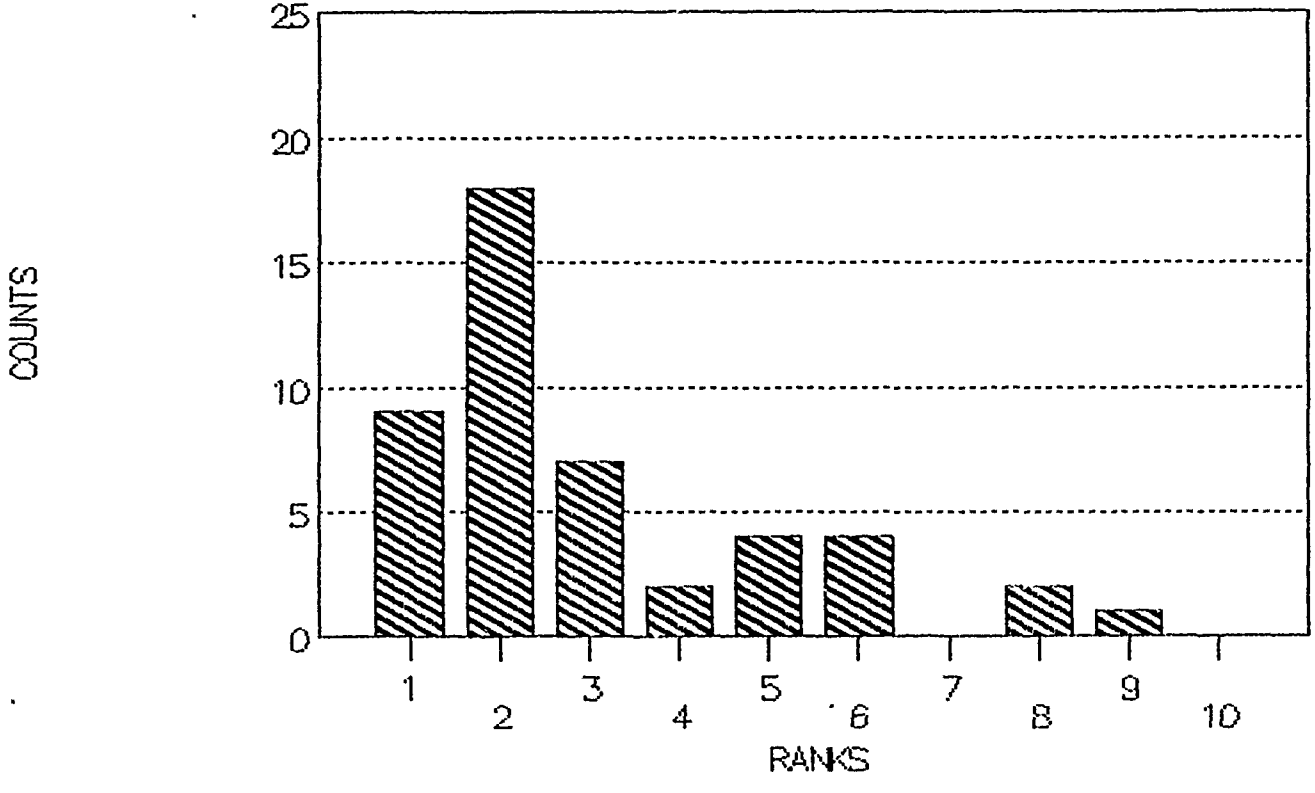
RANKS

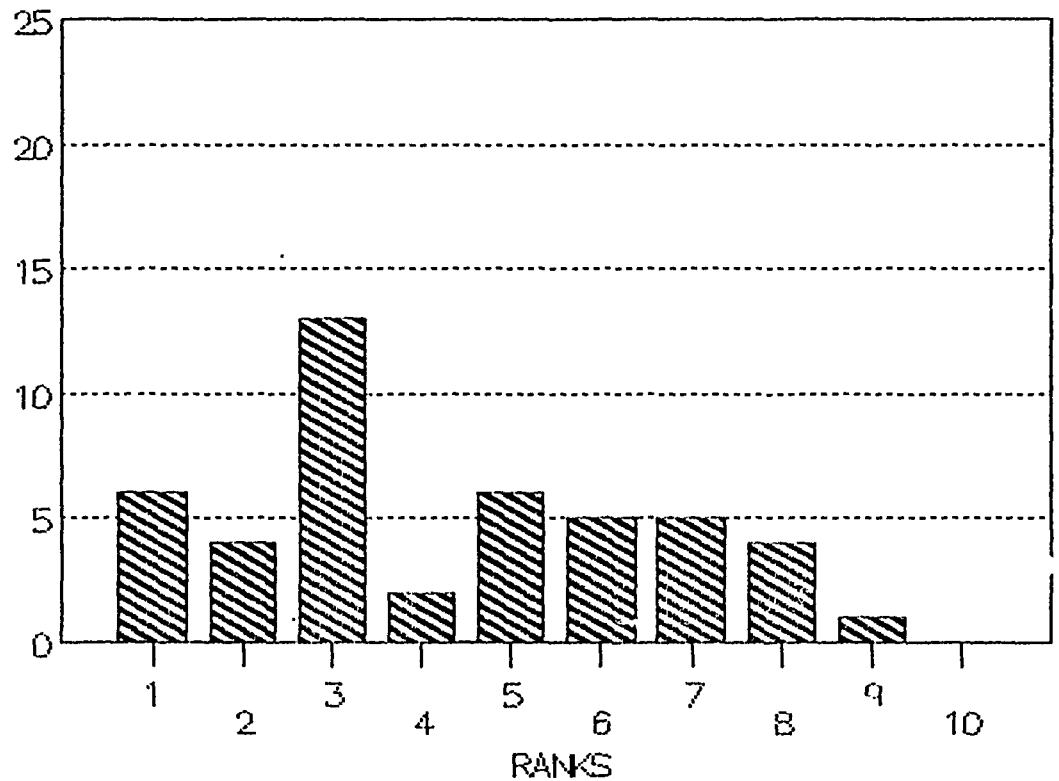
POTENTIAL BENEFIT AREAS

REPLENISHMENT



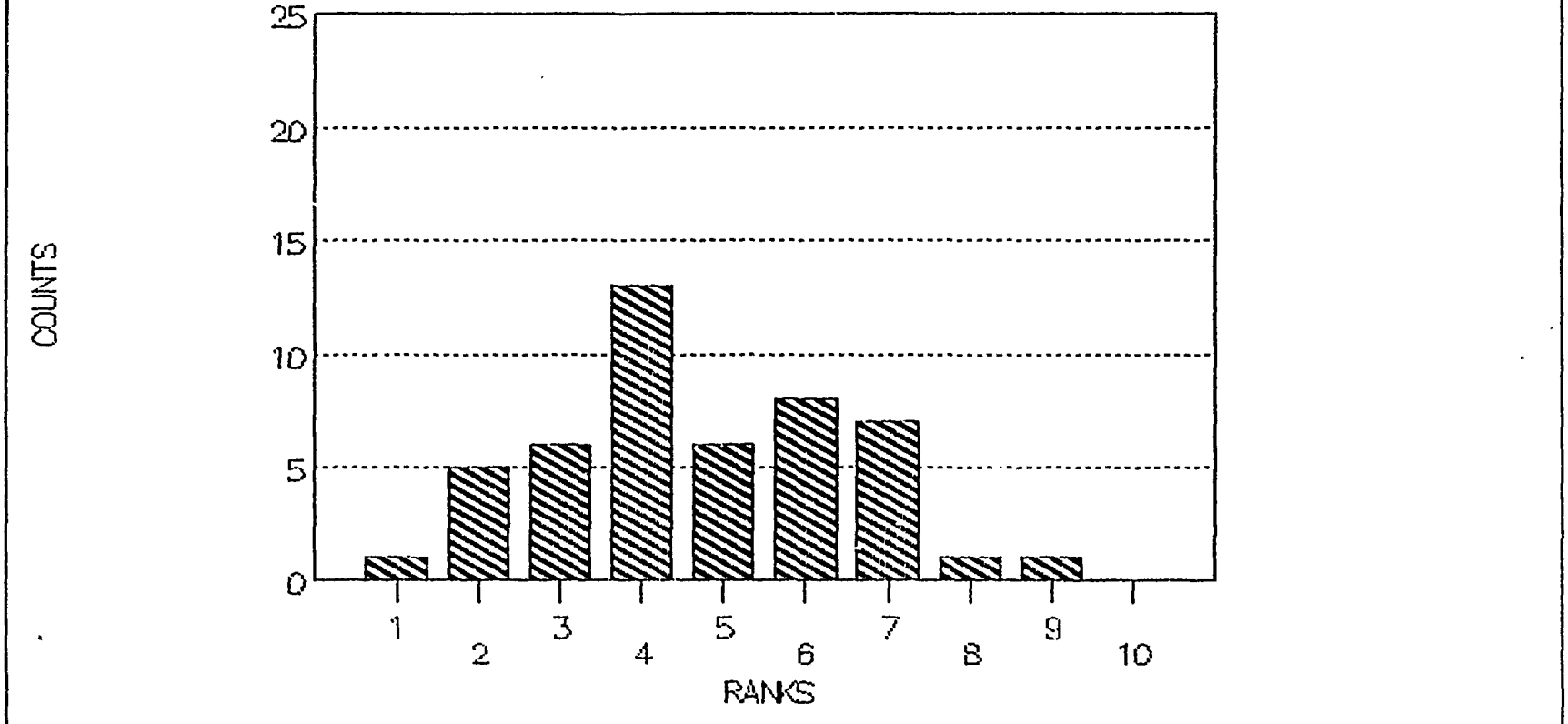
POTENTIAL BENEFIT AREAS

MUTUAL EMERGENCY SUPPLY SUPPORT



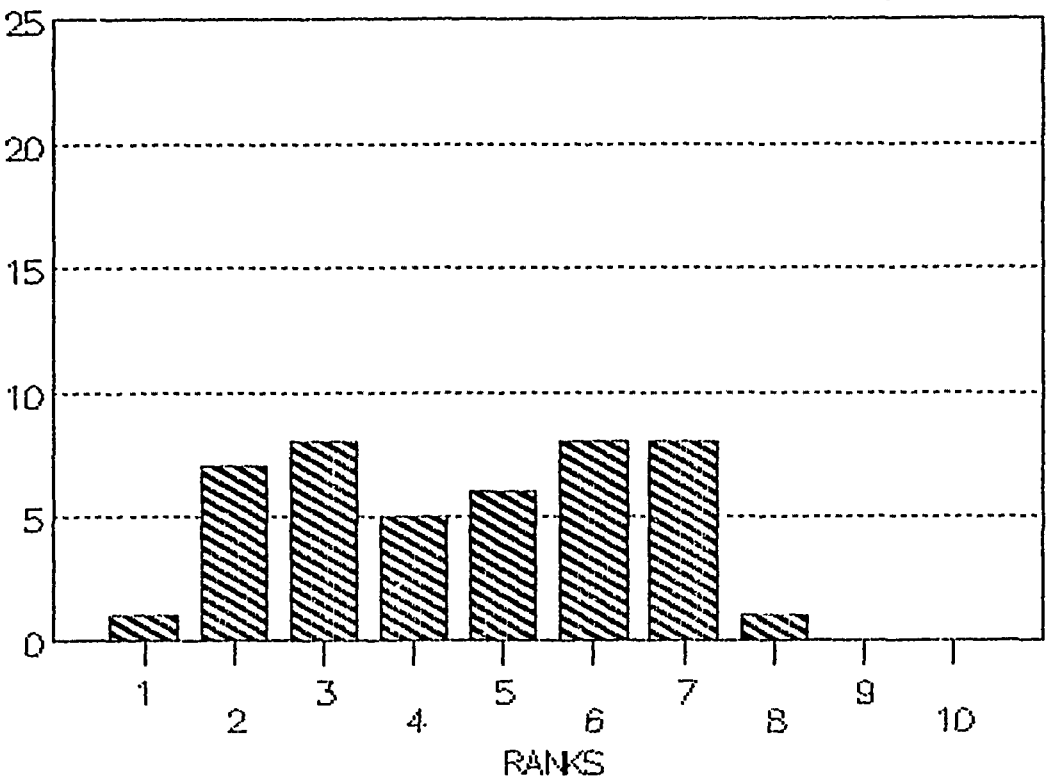
POTENTIAL BENEFIT AREAS

TEST EQUIPMENT



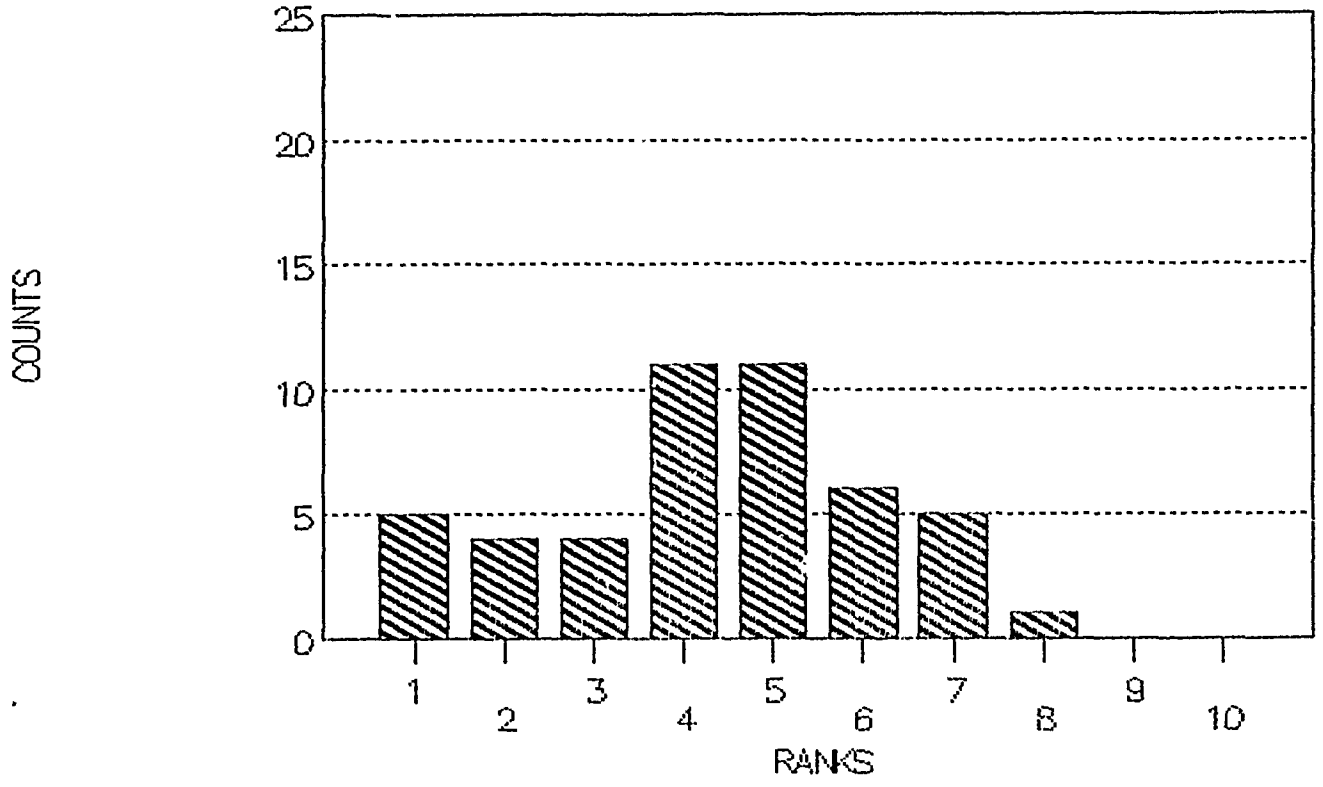
POTENTIAL BENEFIT AREAS

LOAD EQUIPMENT



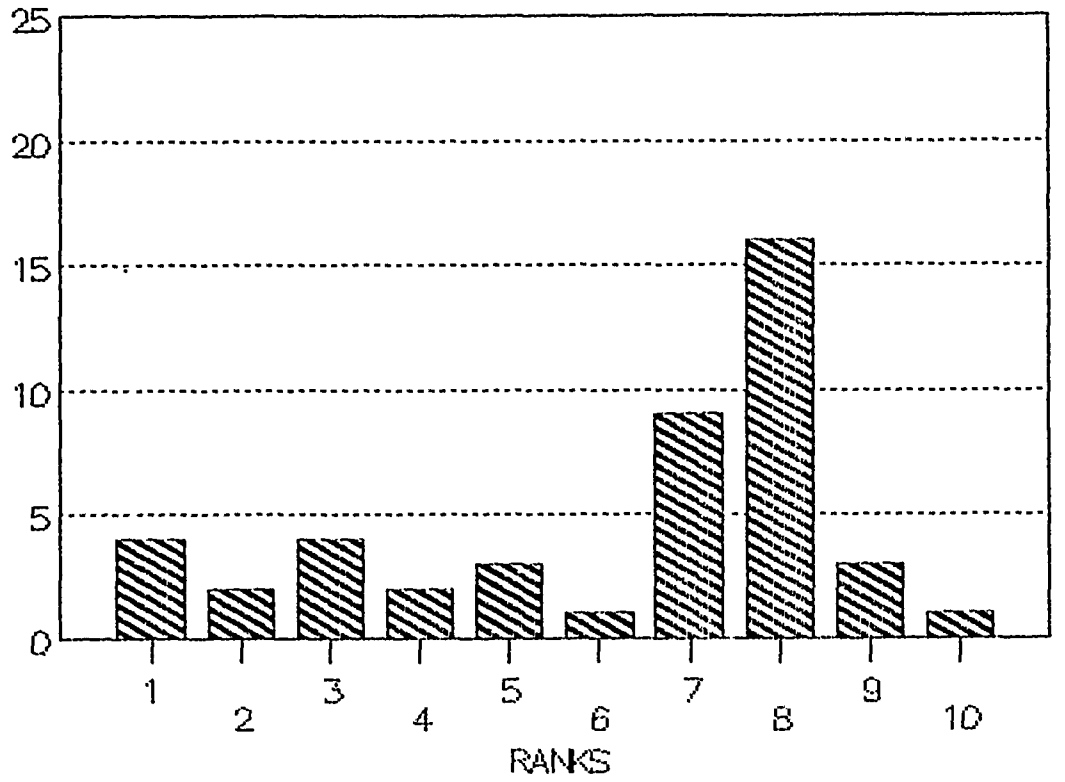
POTENTIAL BENEFIT AREAS

PERSONNEL TRAINING



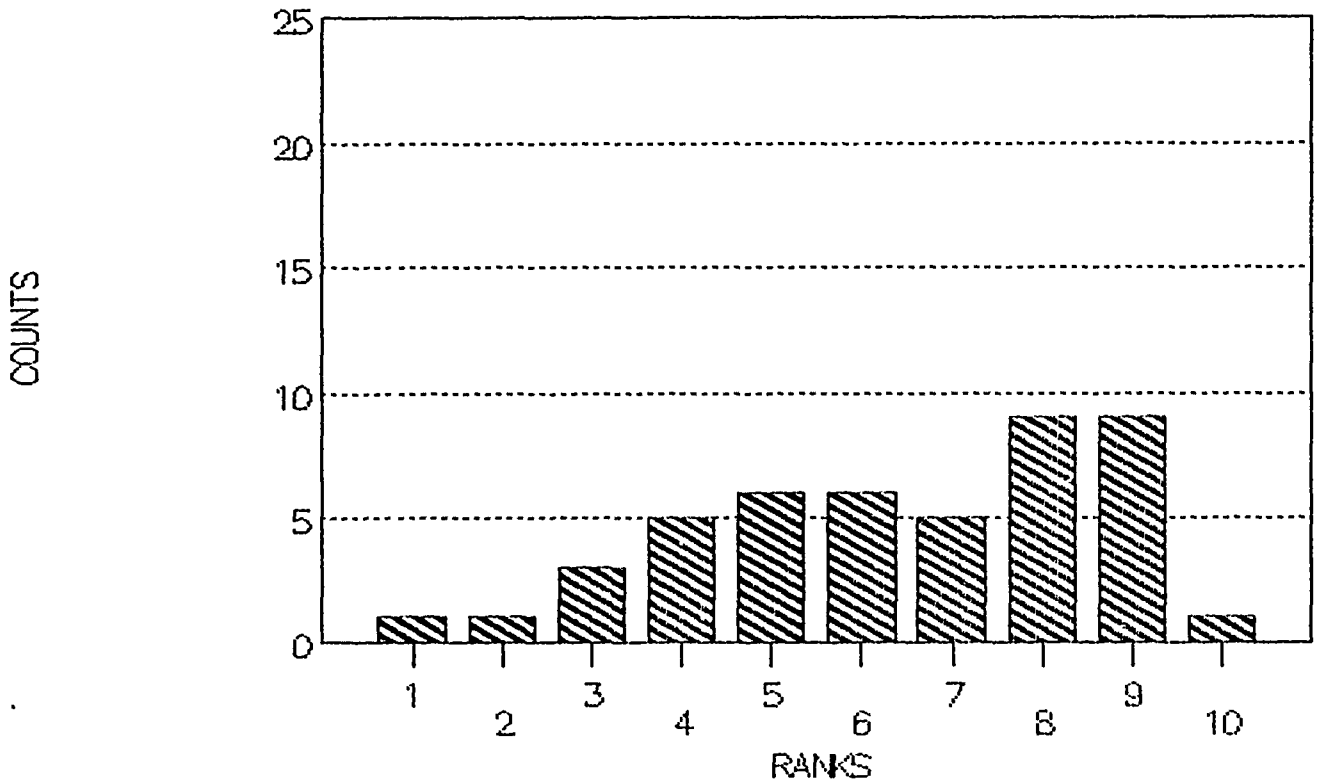
POTENTIAL BENEFIT AREAS

MATERIEL POLICIES



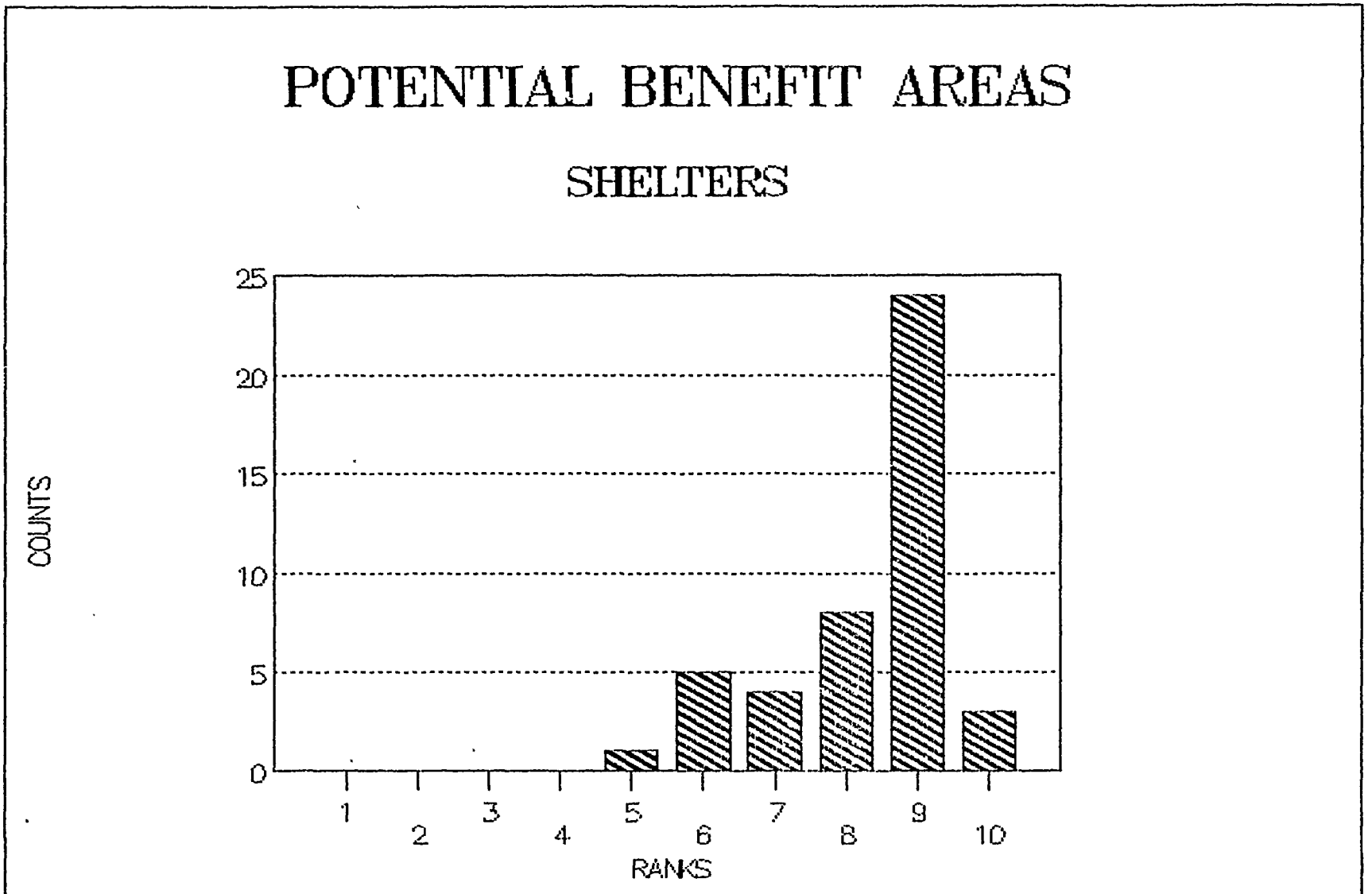
POTENTIAL BENEFIT AREAS

TECHNICAL PUBLICATIONS



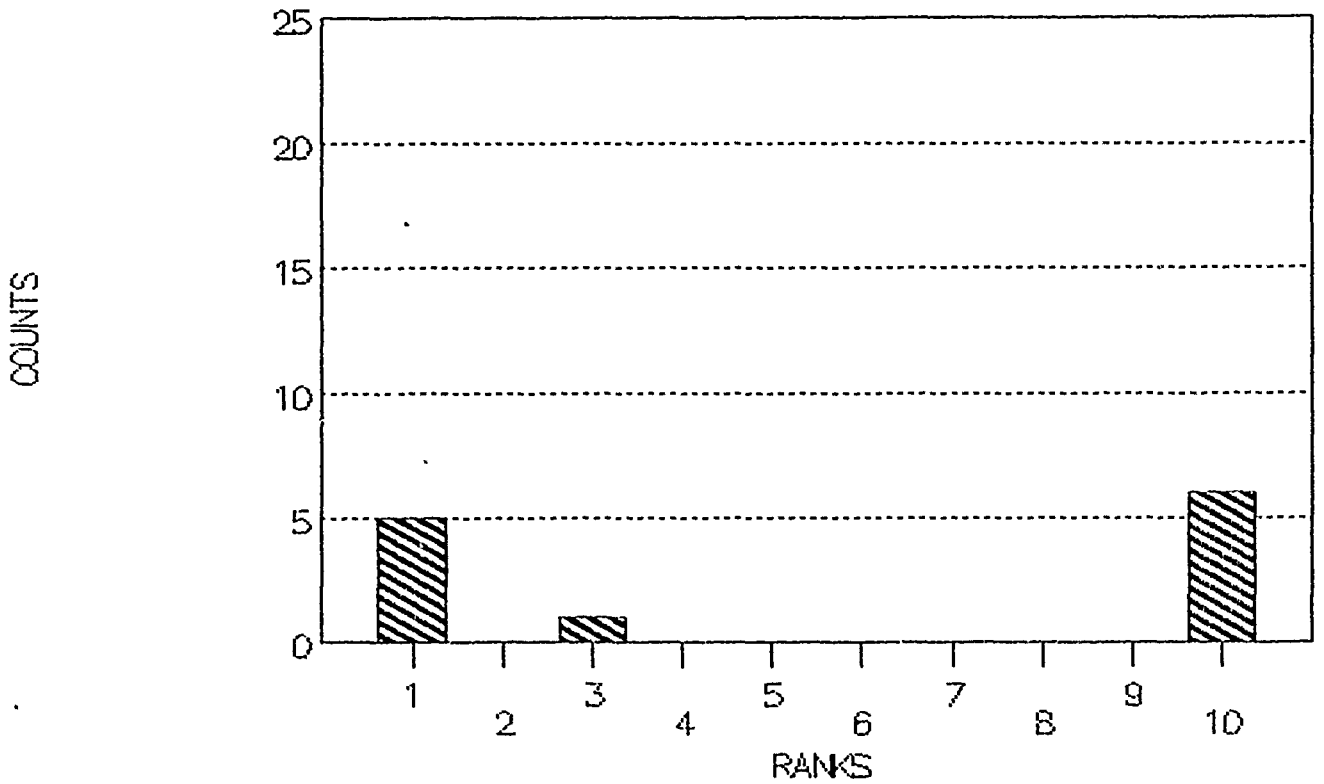
POTENTIAL BENEFIT AREAS

SHELTERS



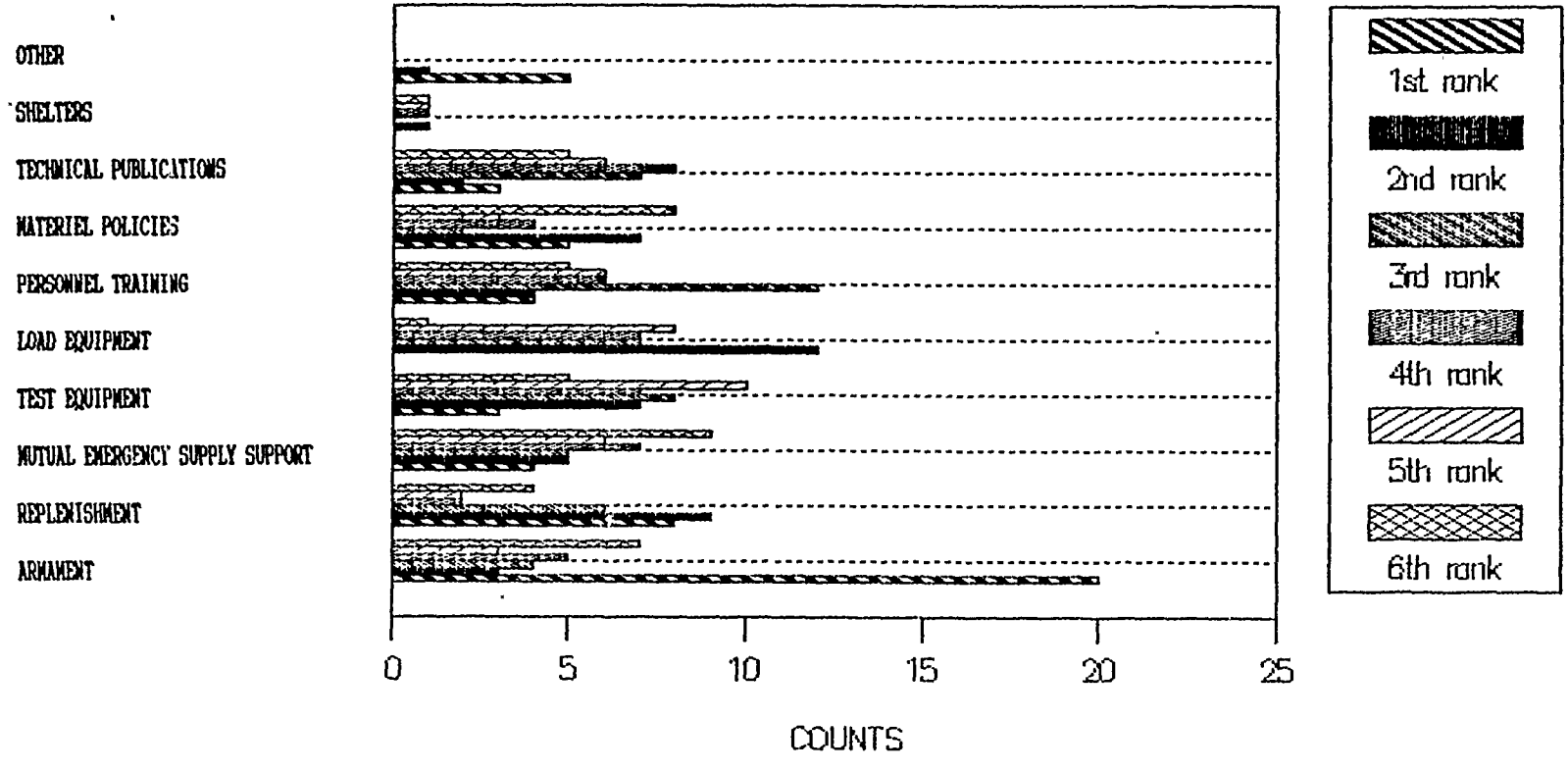
POTENTIAL BENEFIT AREAS

OTHER



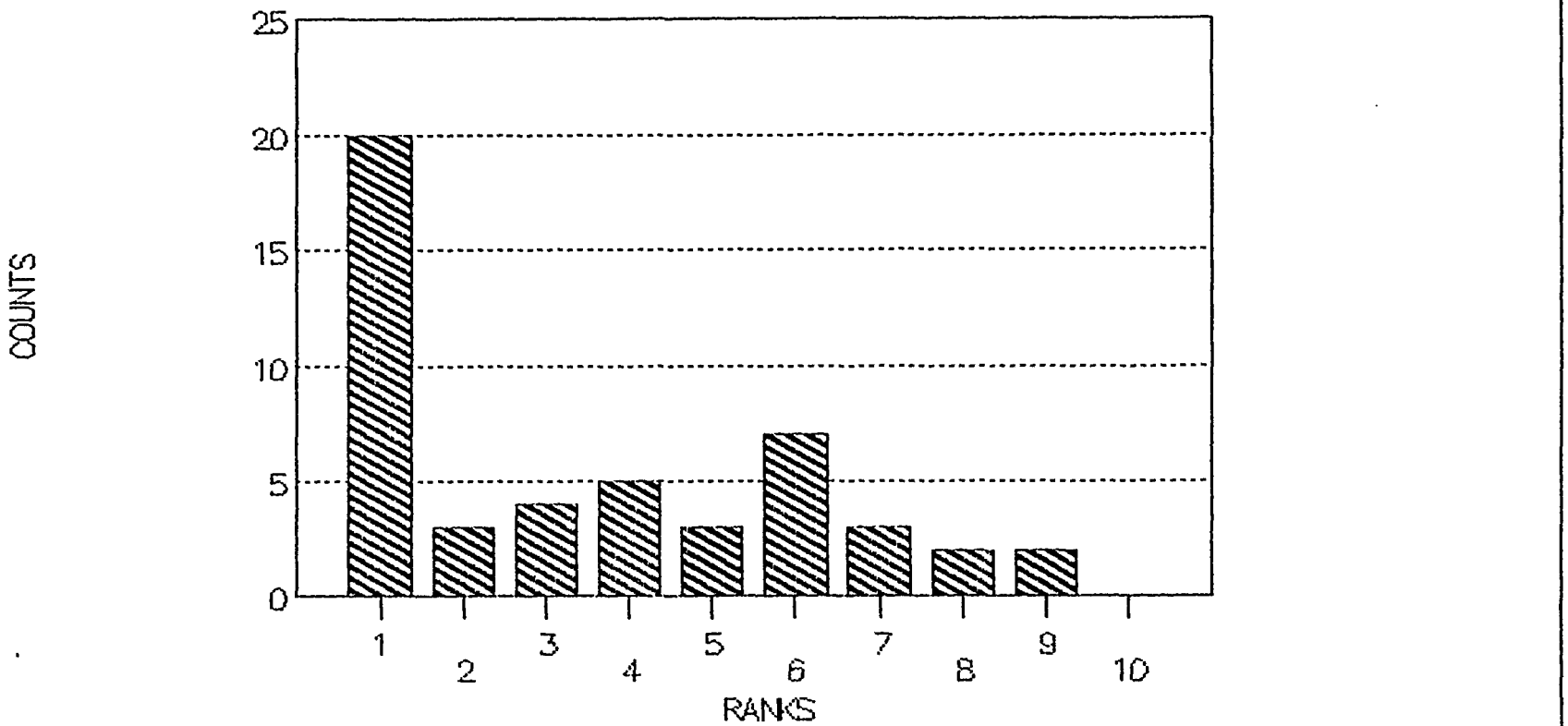
CROSS SERVICING PROBLEM SOLUTIONS

OPPORTUNITY FOR IMPROVED RSI



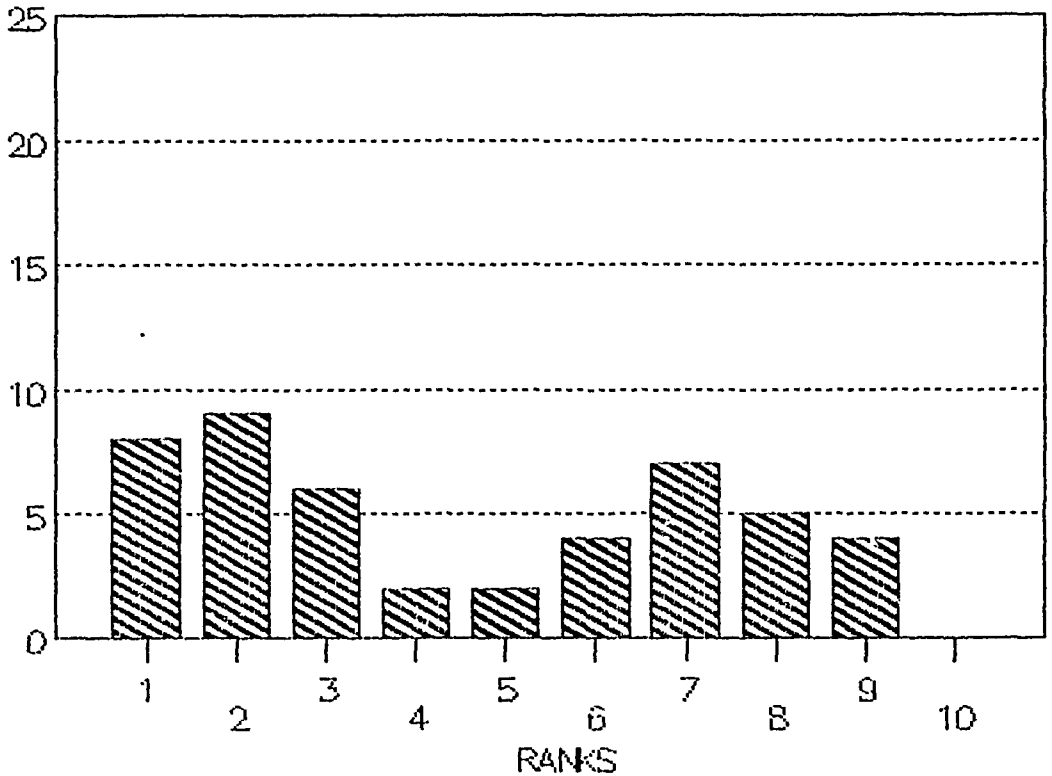
OPPORTUNITY FOR IMPROVED RSI

ARMAMENT



OPPORTUNITY FOR IMPROVED RSI

REPLENISHMENT



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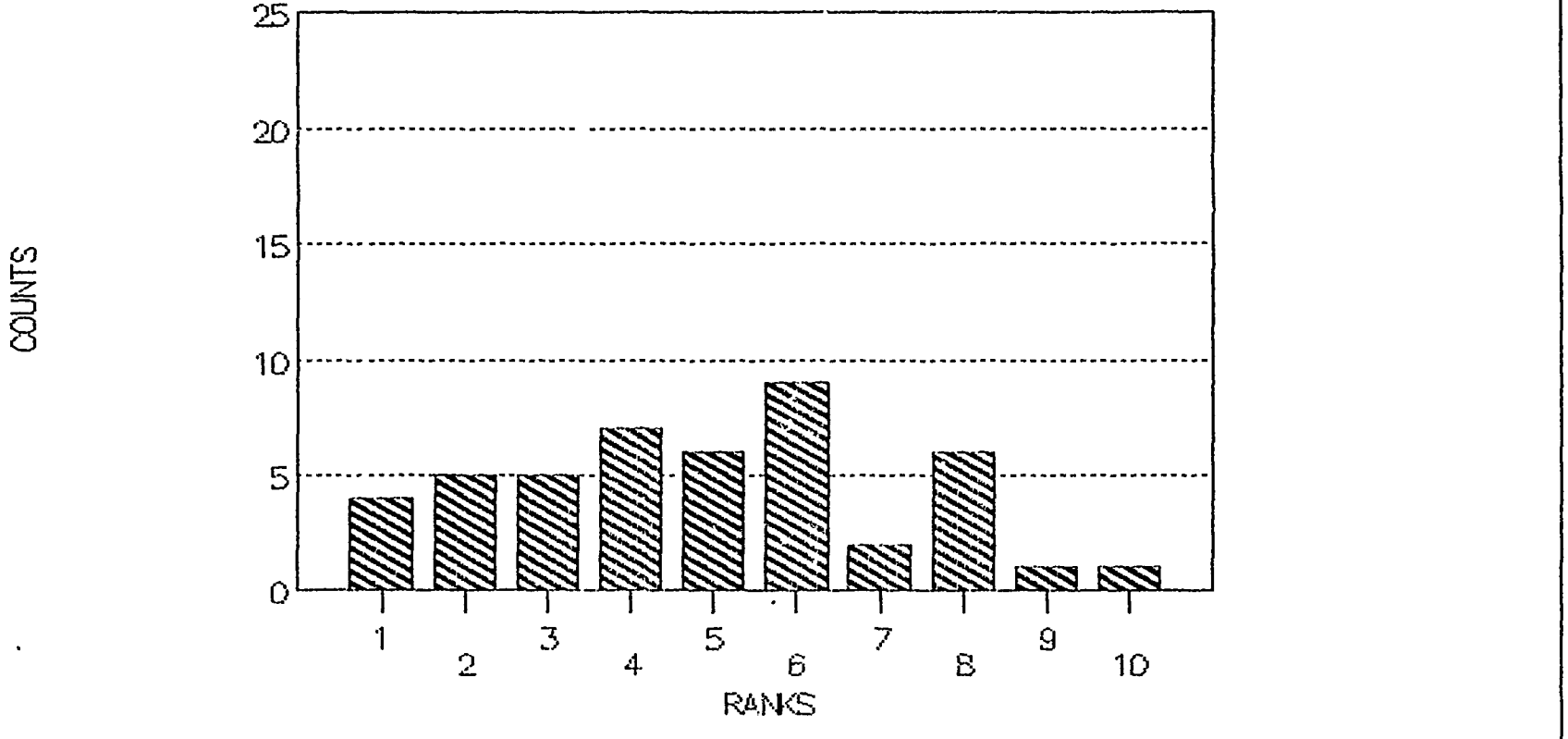

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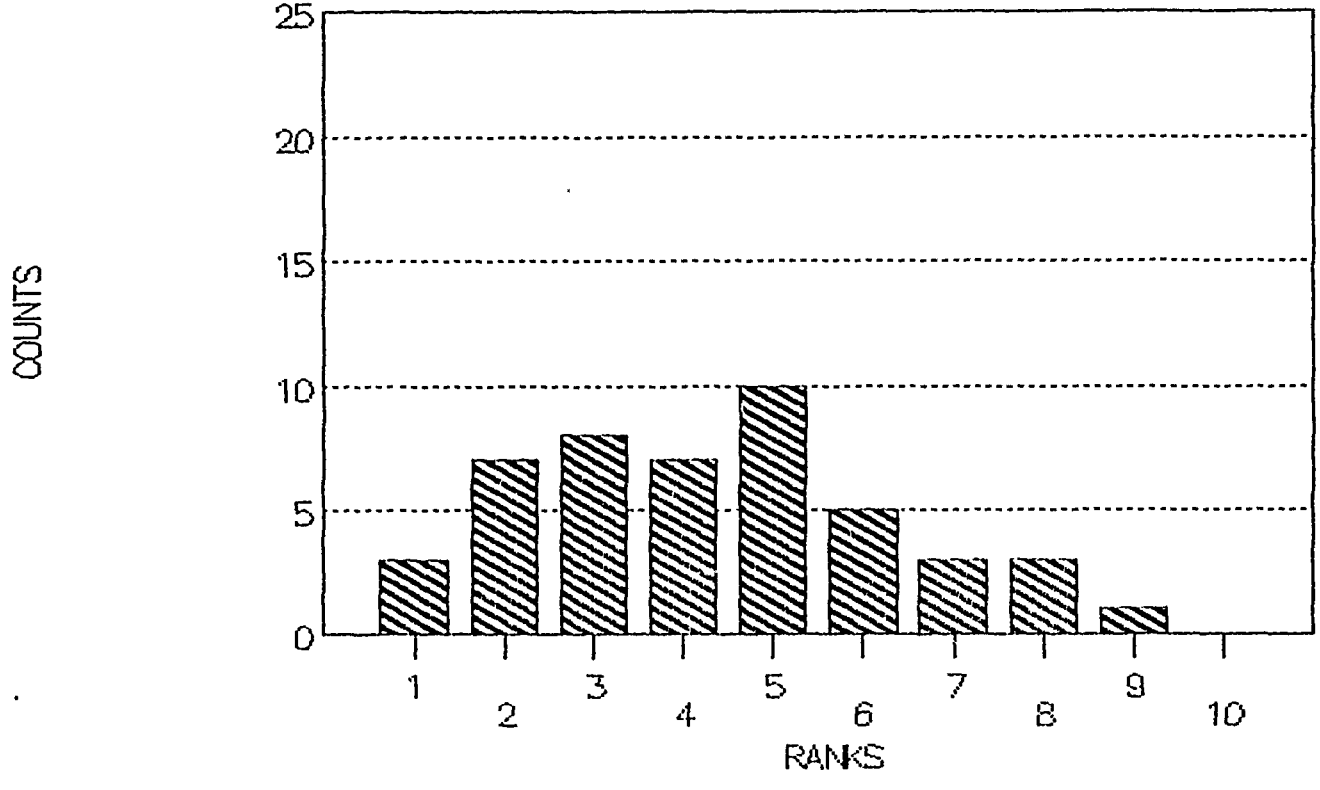

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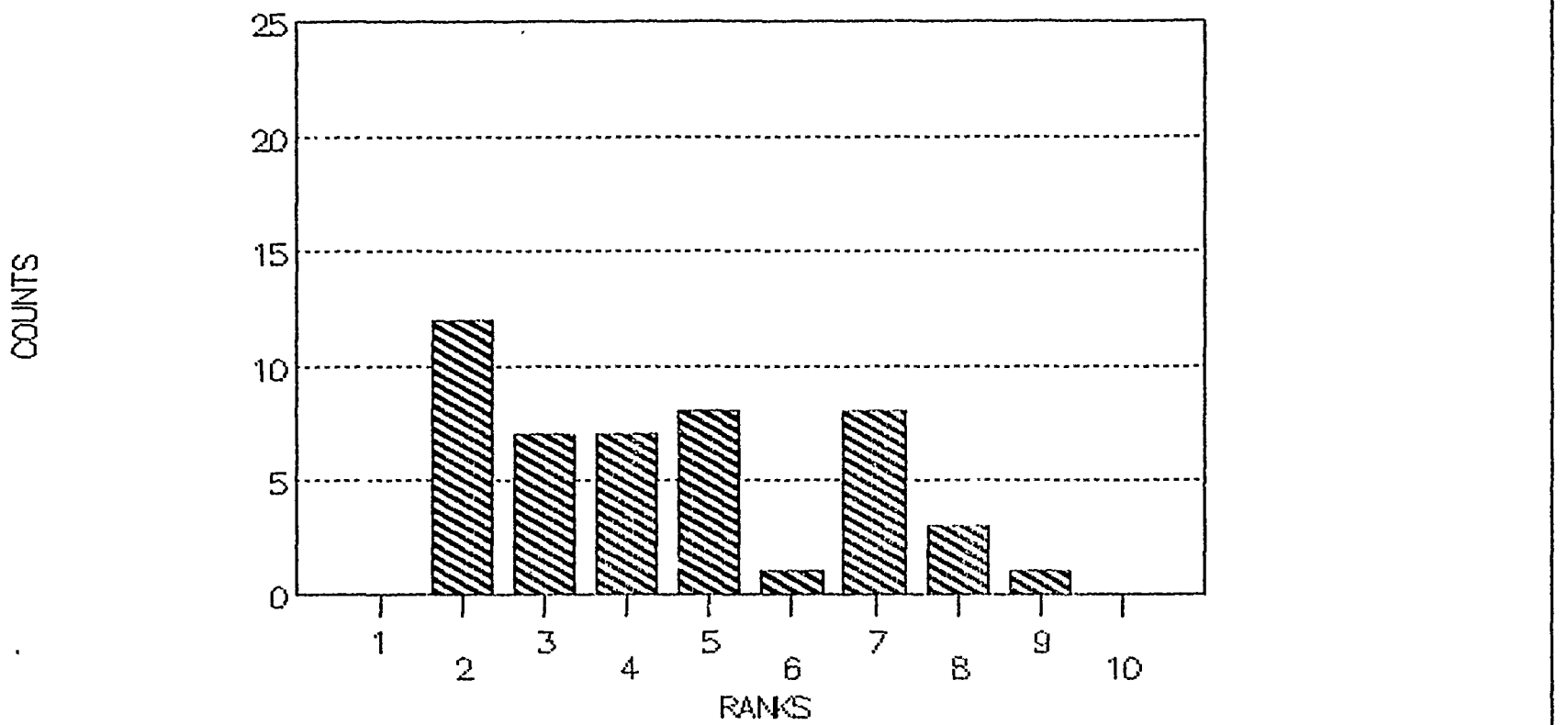

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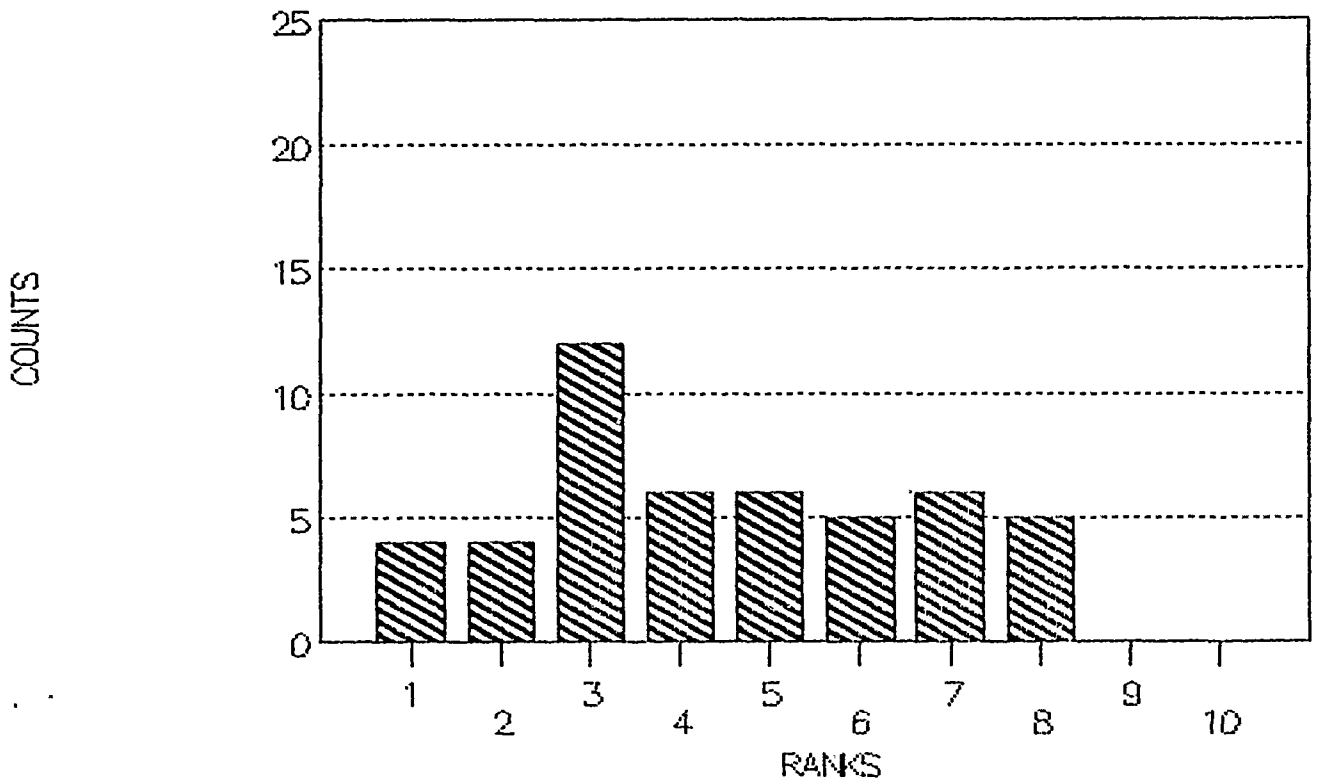

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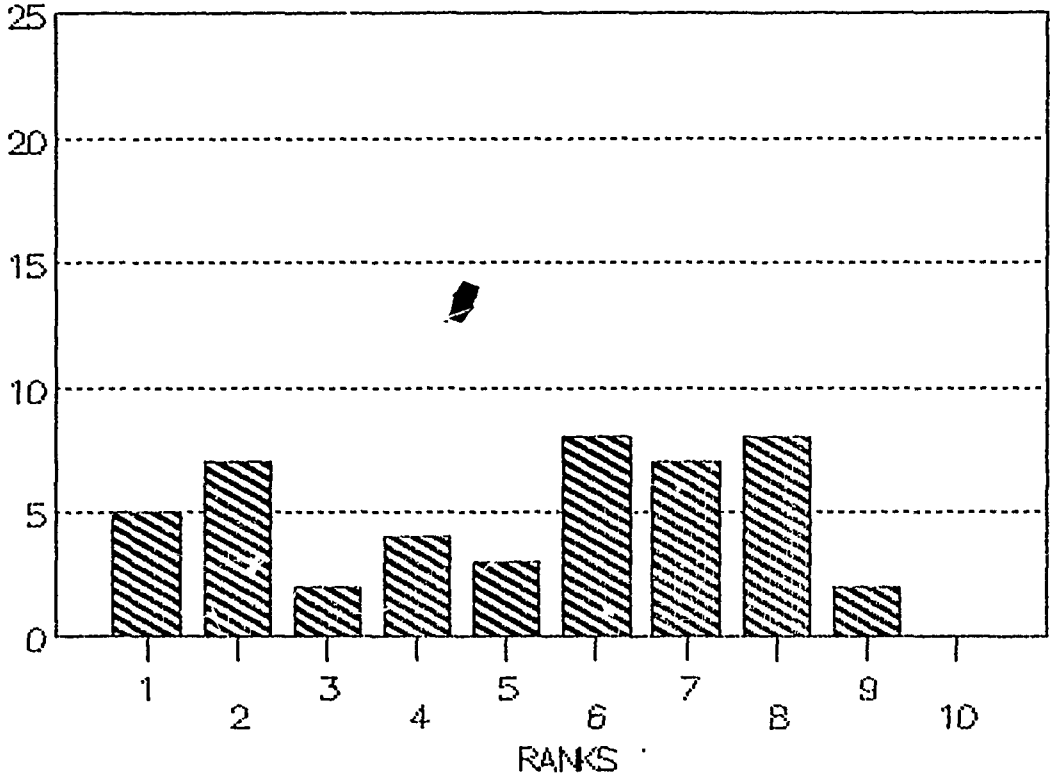

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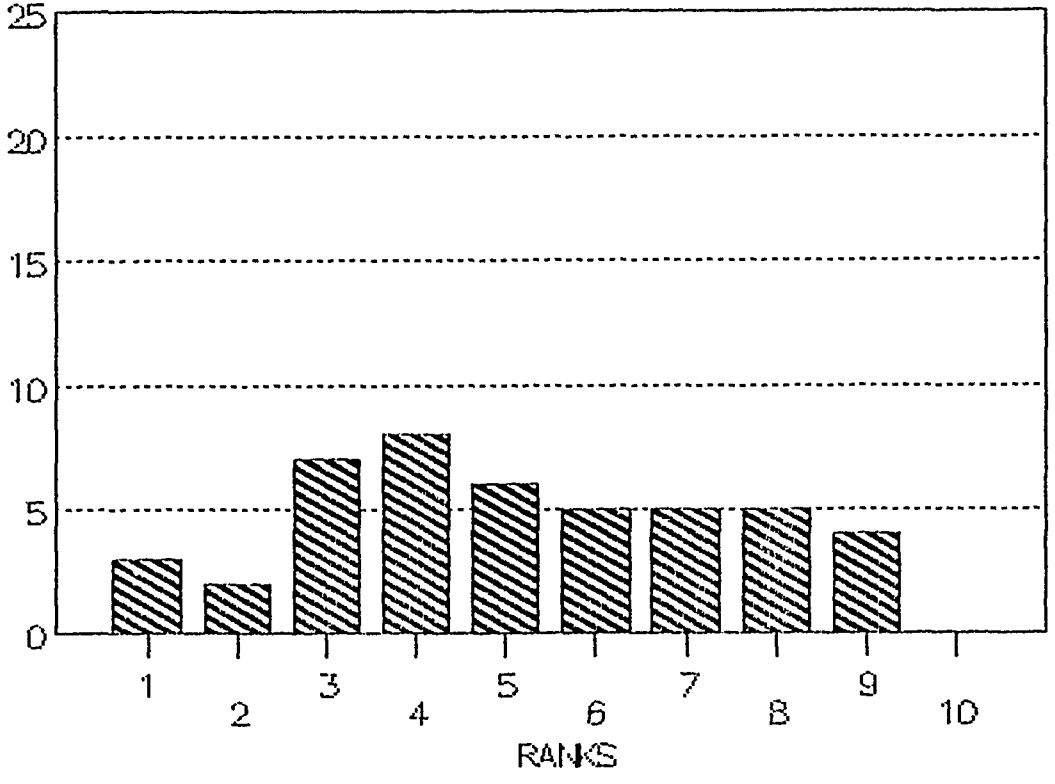

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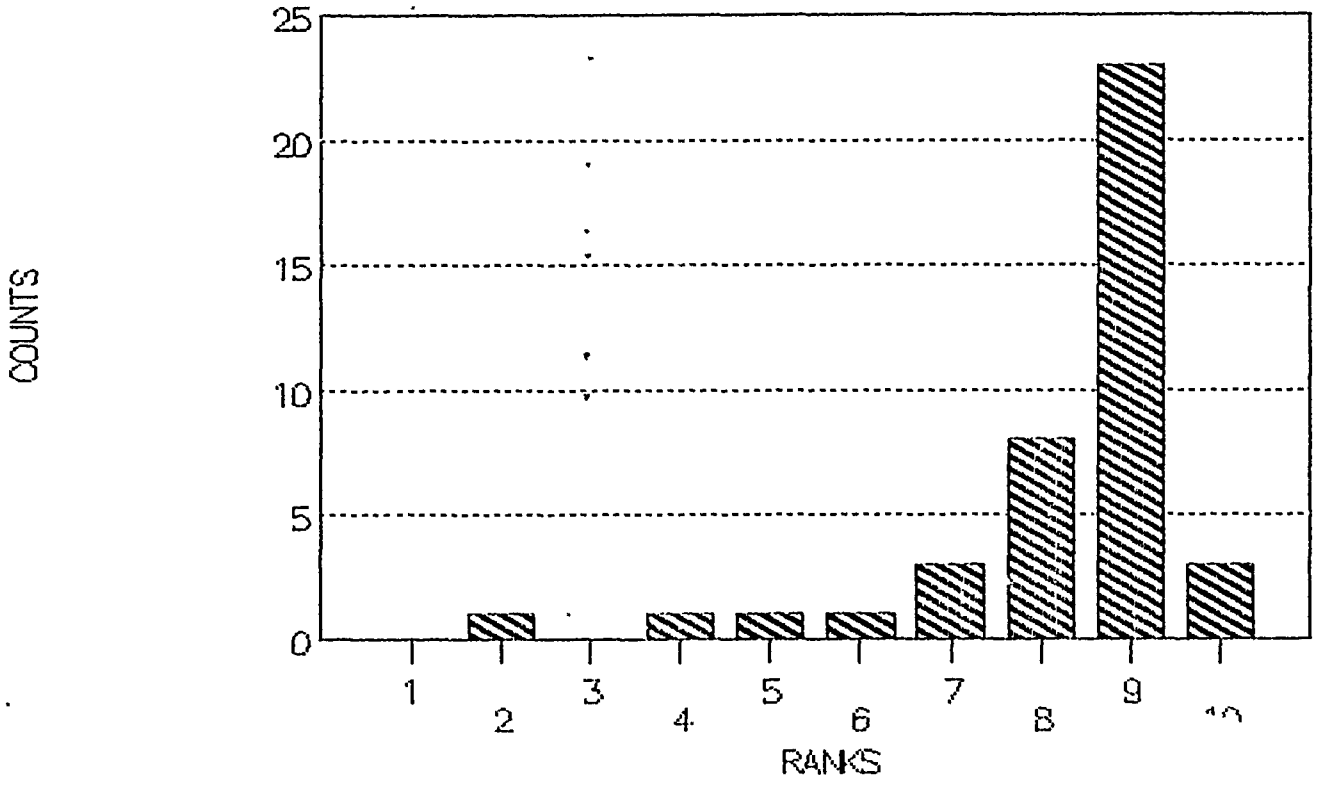

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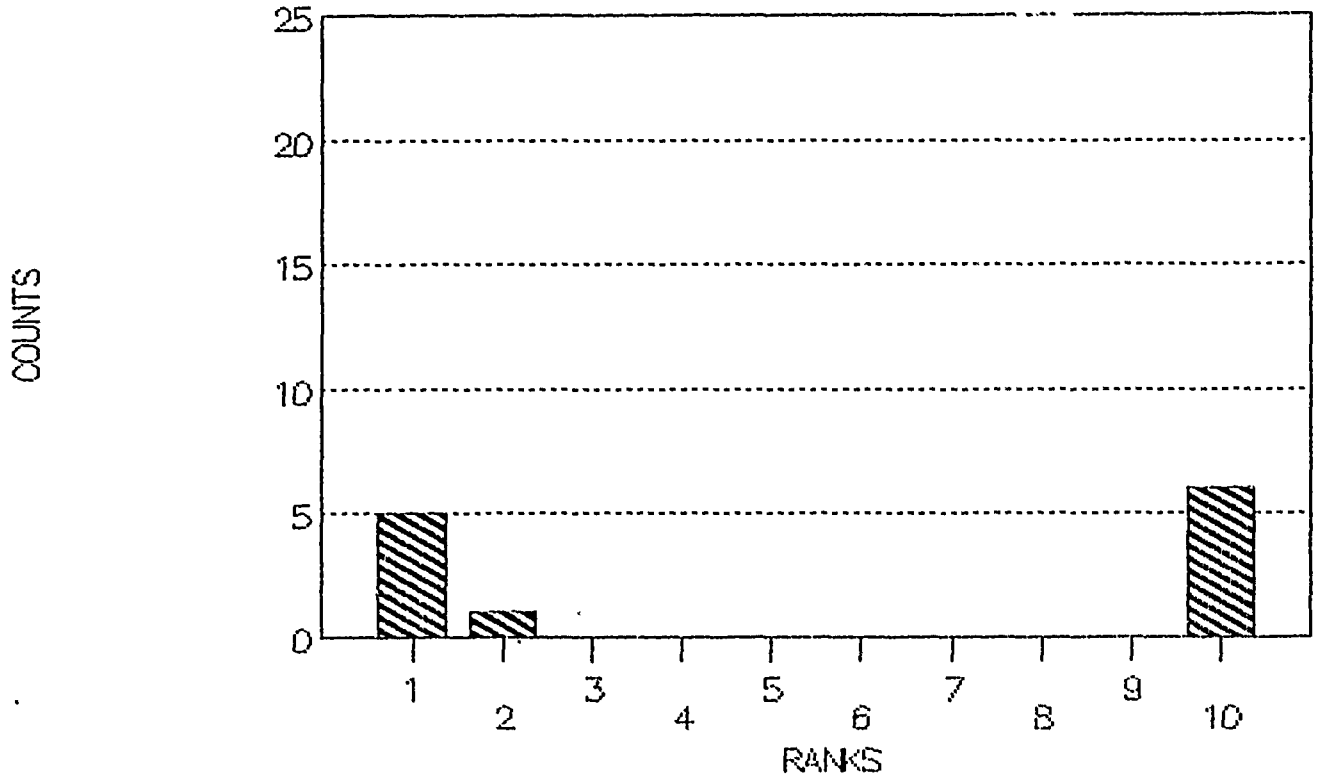
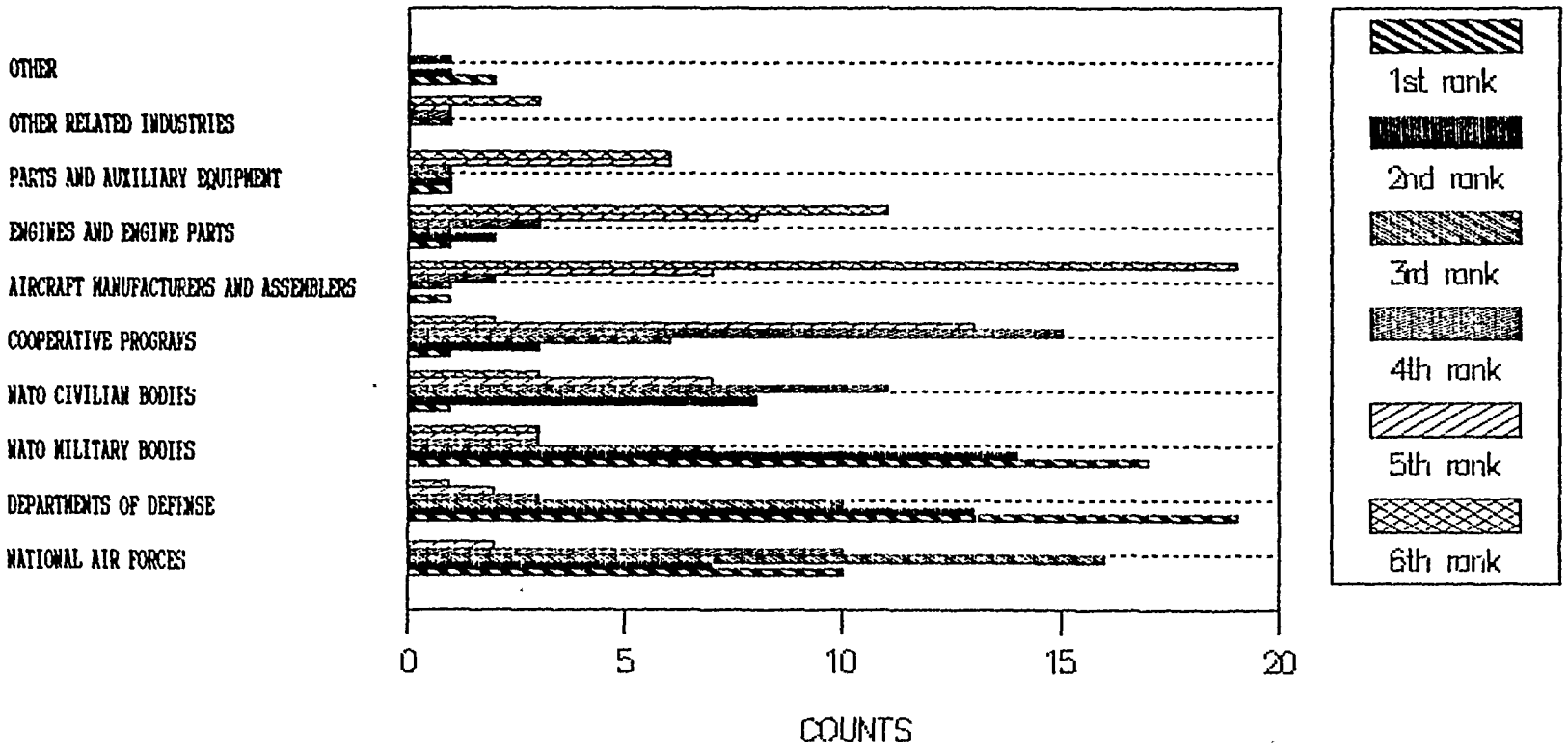
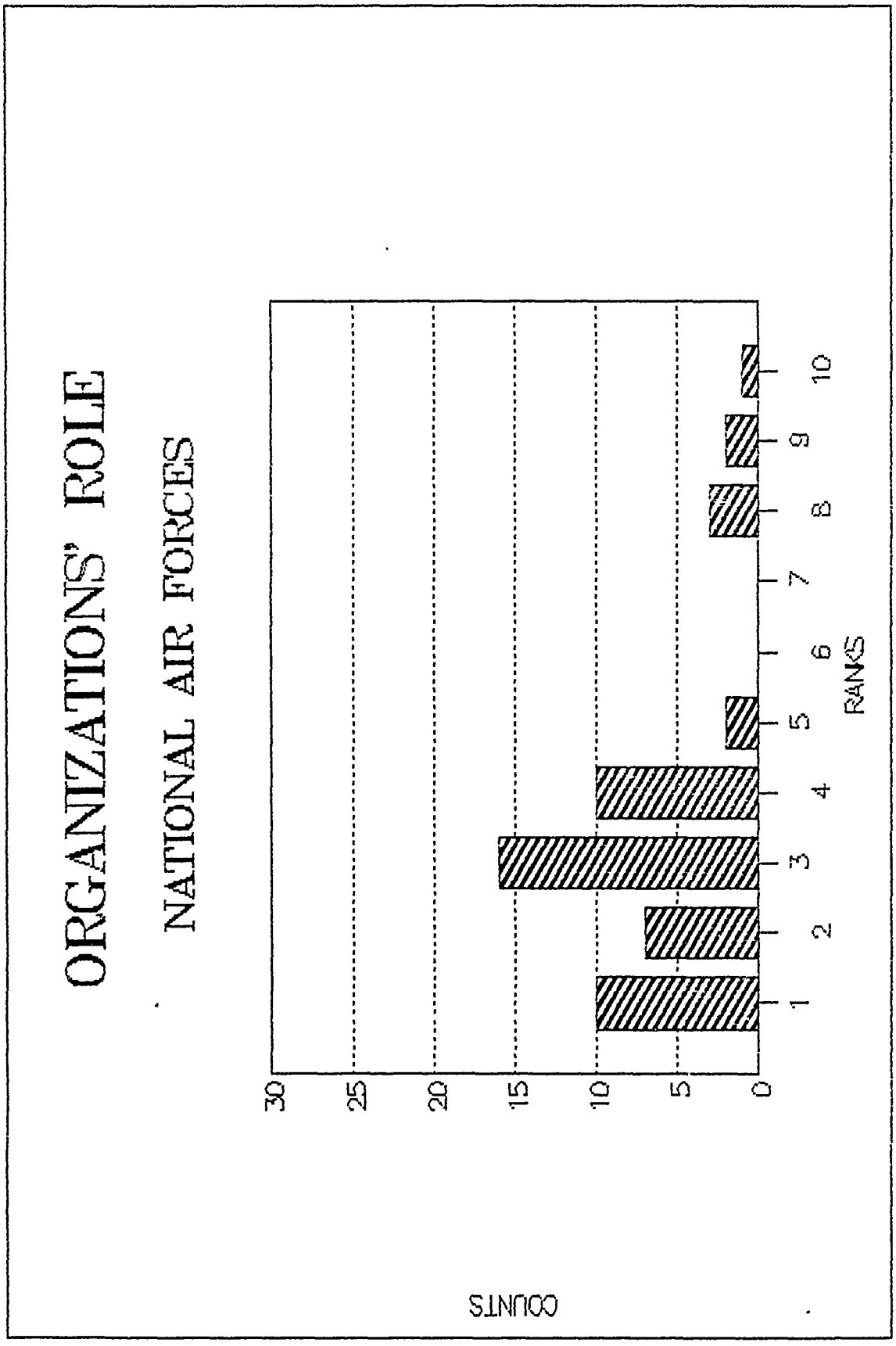


CROSS SERVICING PROBLEM SOLUTIONS

ORGANIZATIONS ROLE IN THE SOLUTION

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RANKS

ORGANIZATIONS' ROLE

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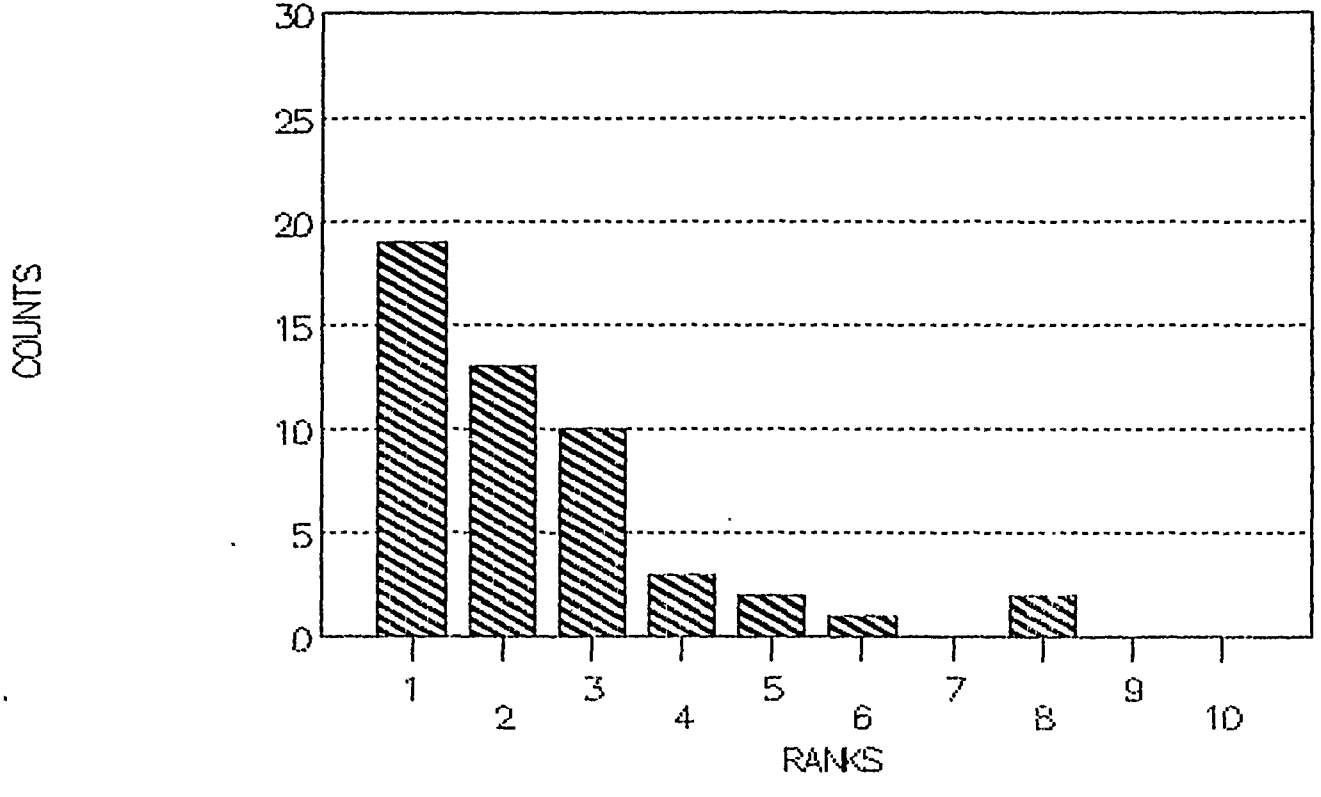

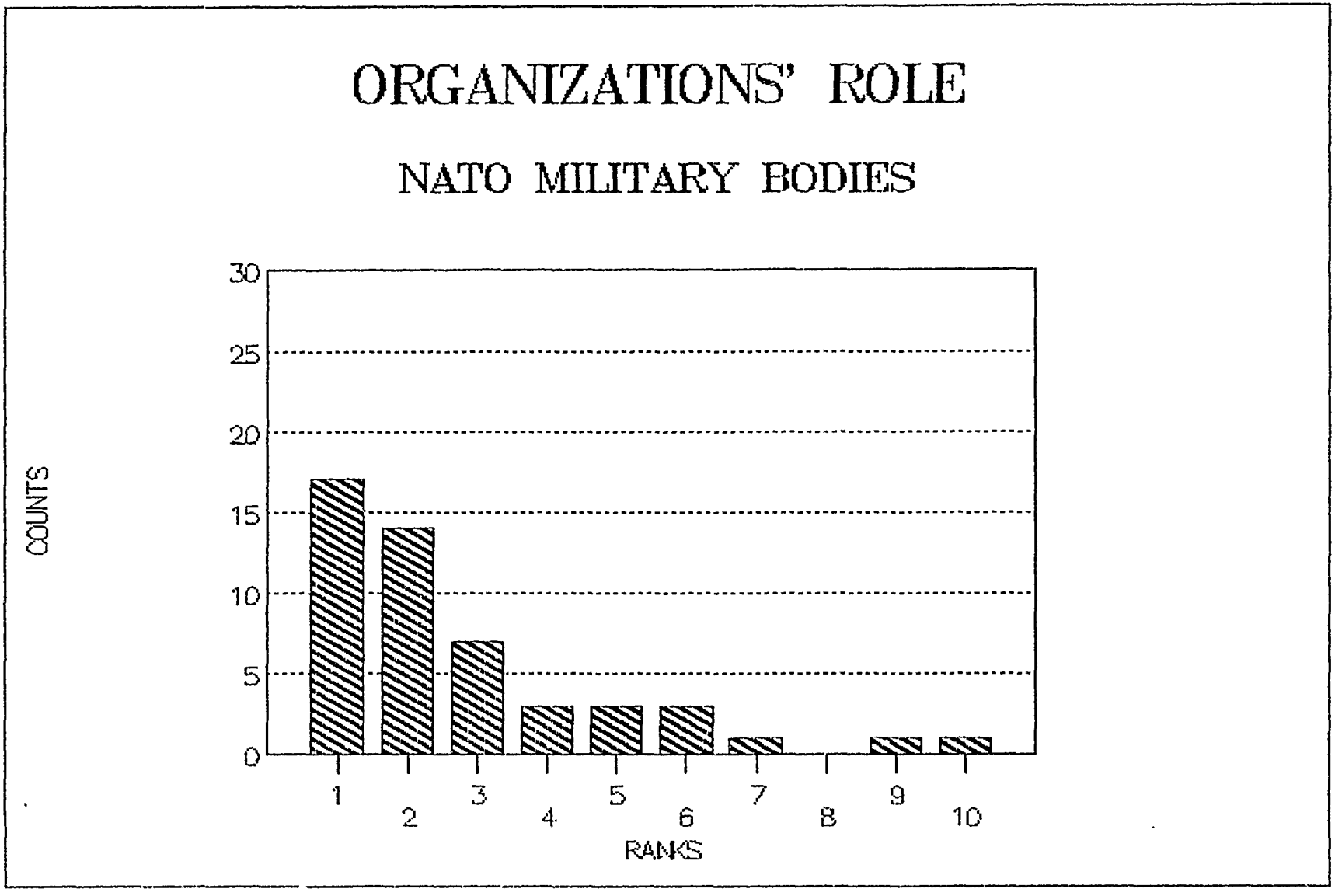
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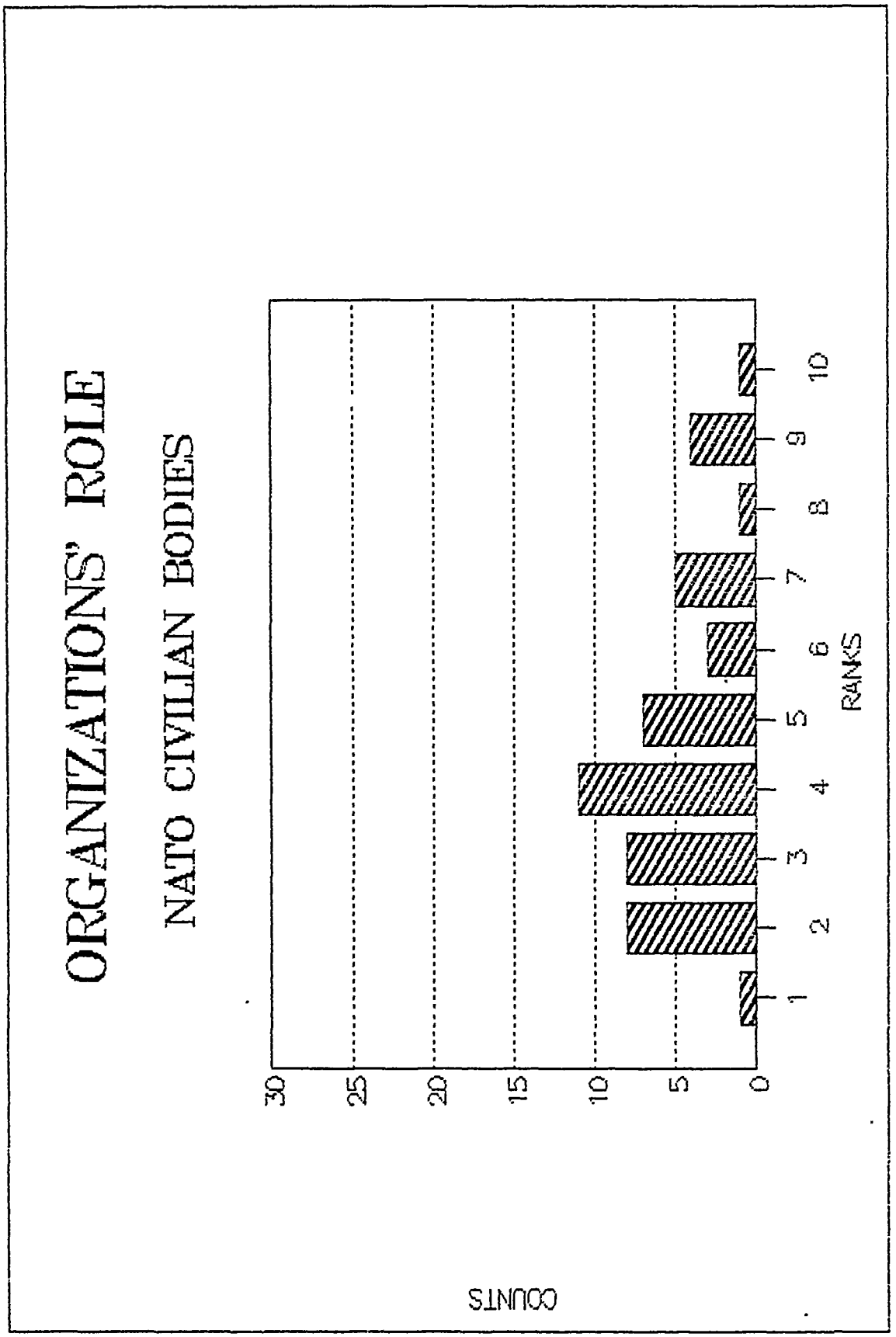
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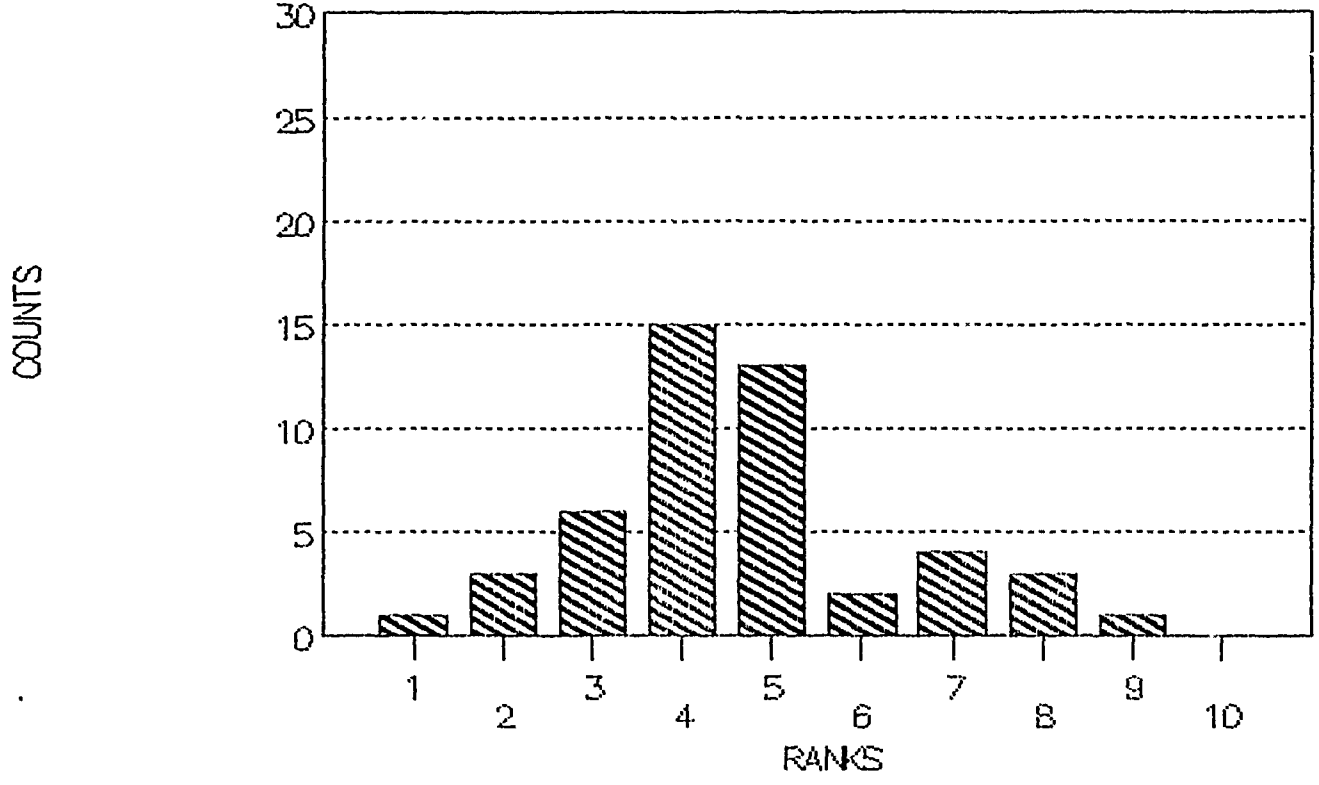
ORGANIZATIONS' ROLE

COOPERATIVE PROGRAMS



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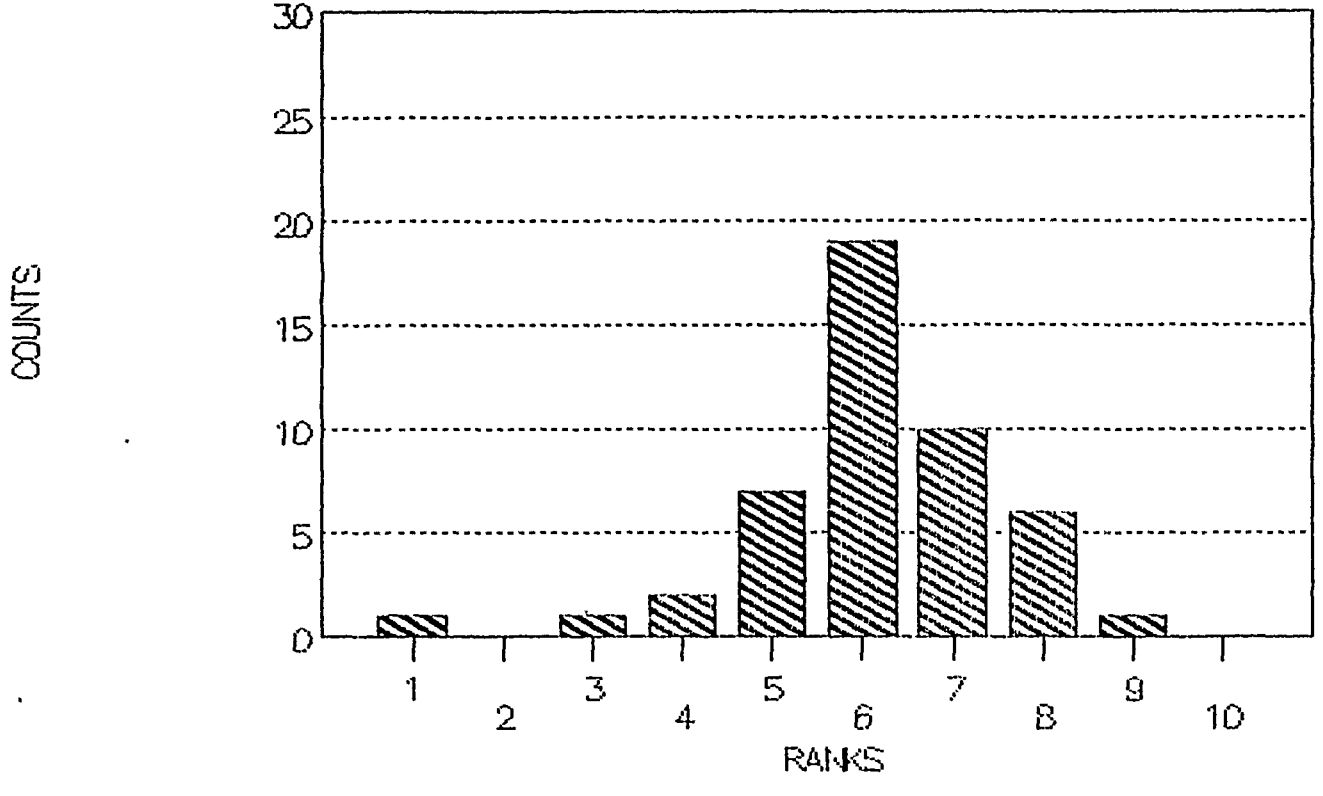

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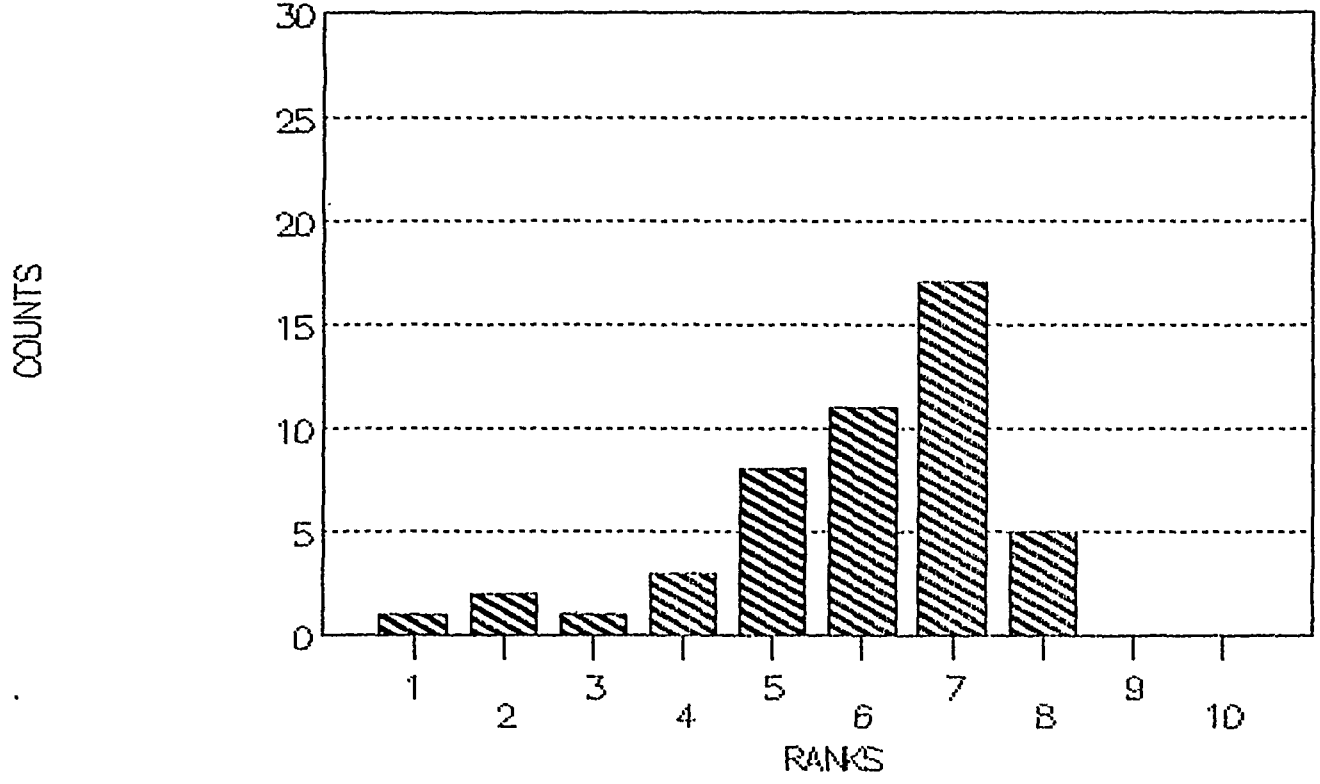
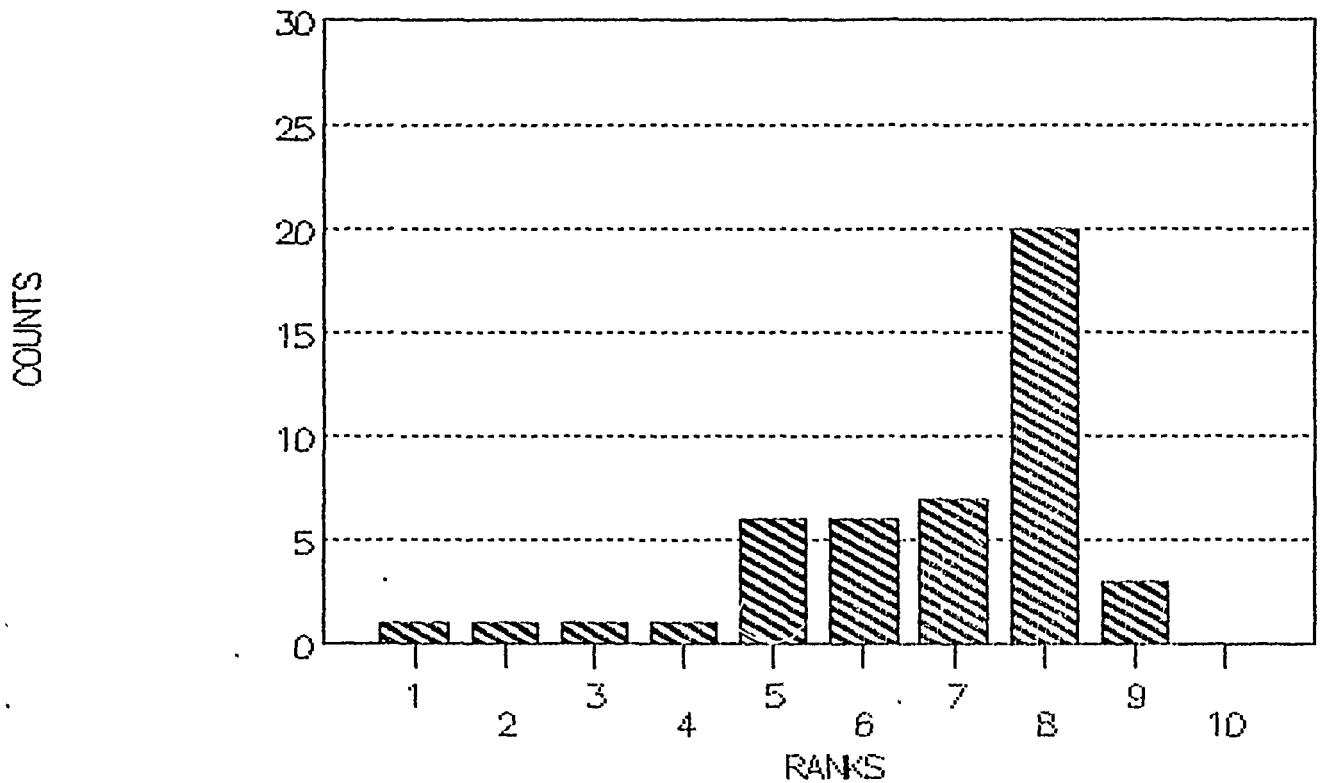
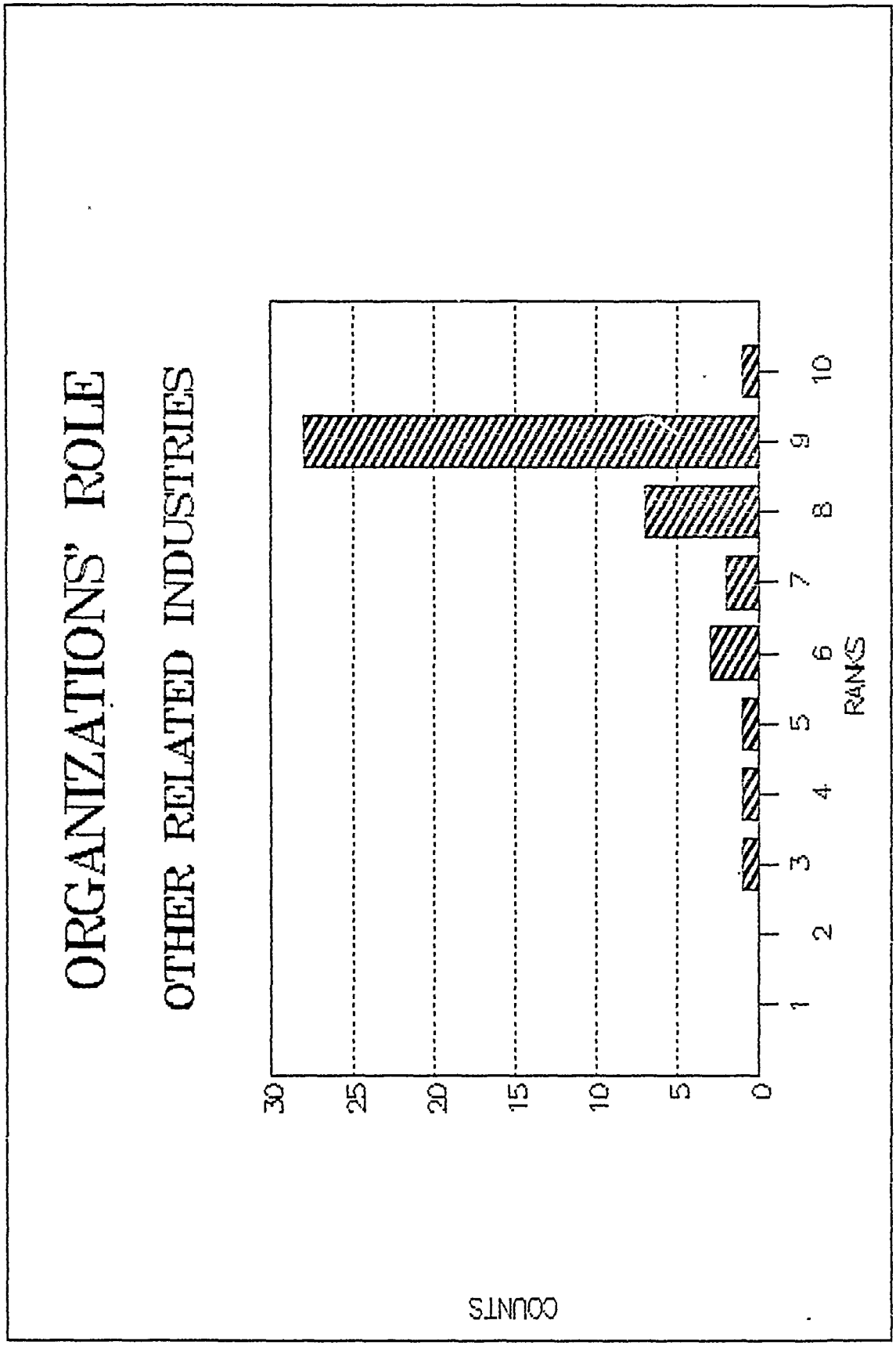


ORGANIZATIONS' ROLE

PARTS AND AUXILIARY EQUIPMENT

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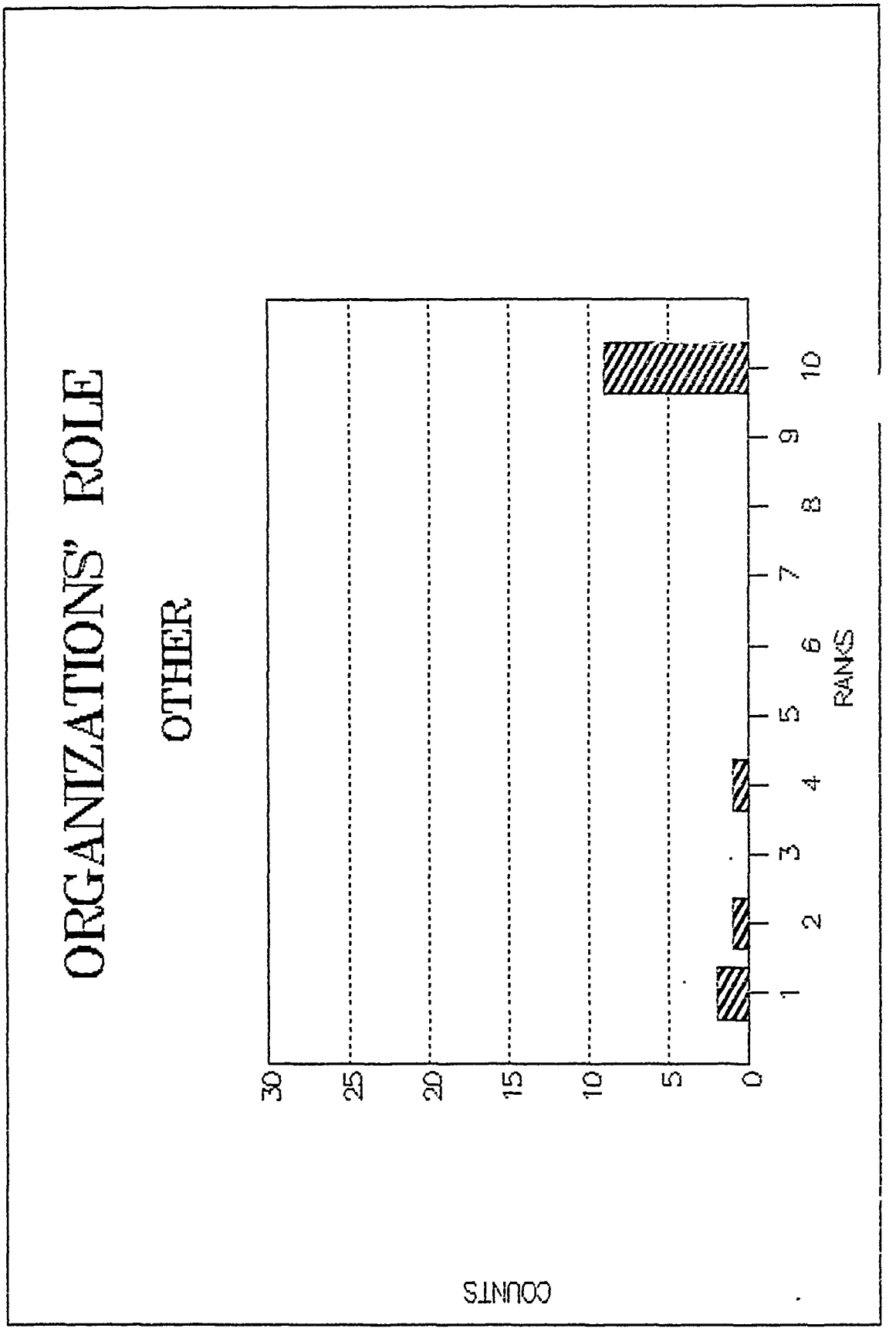
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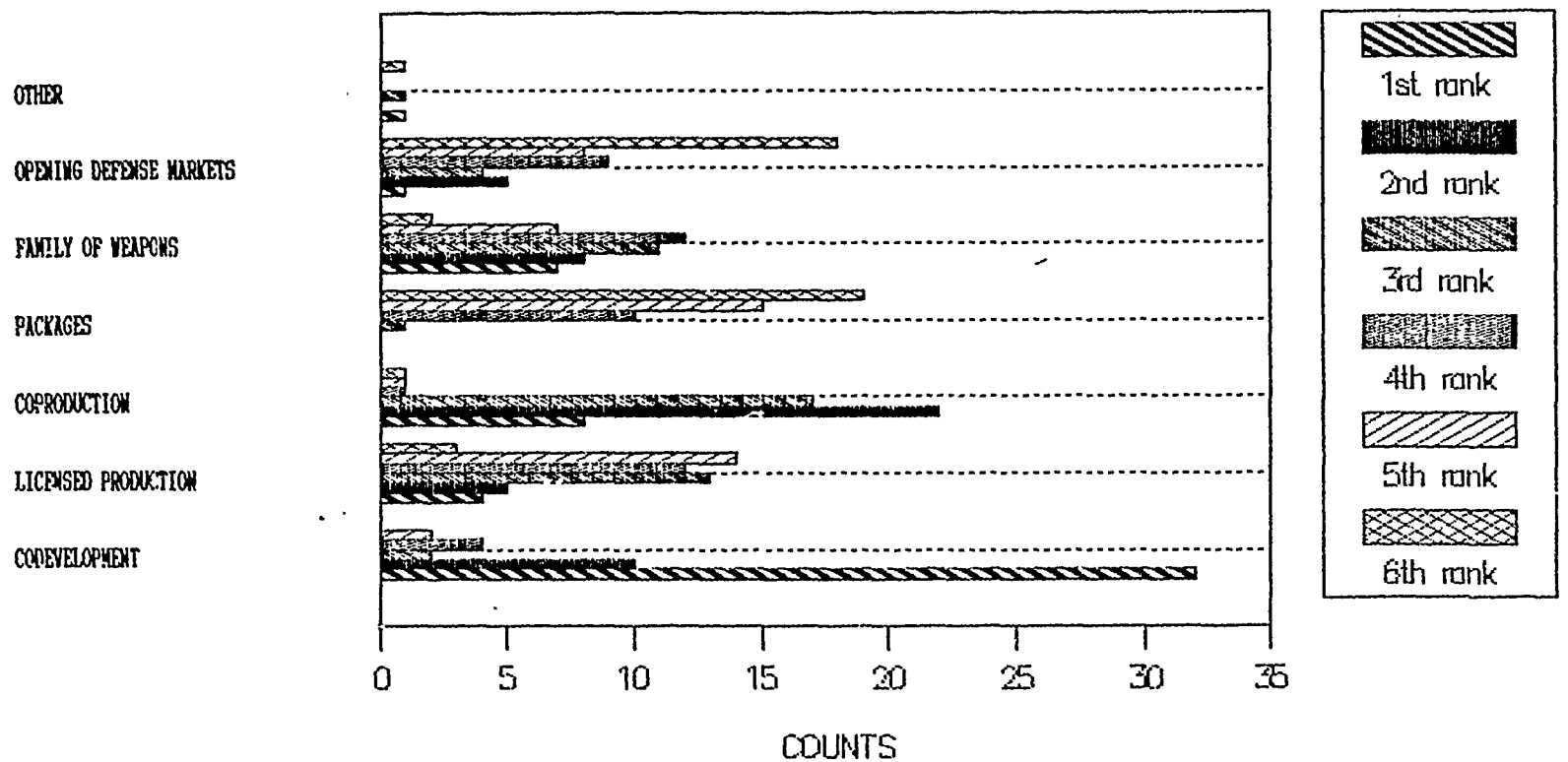
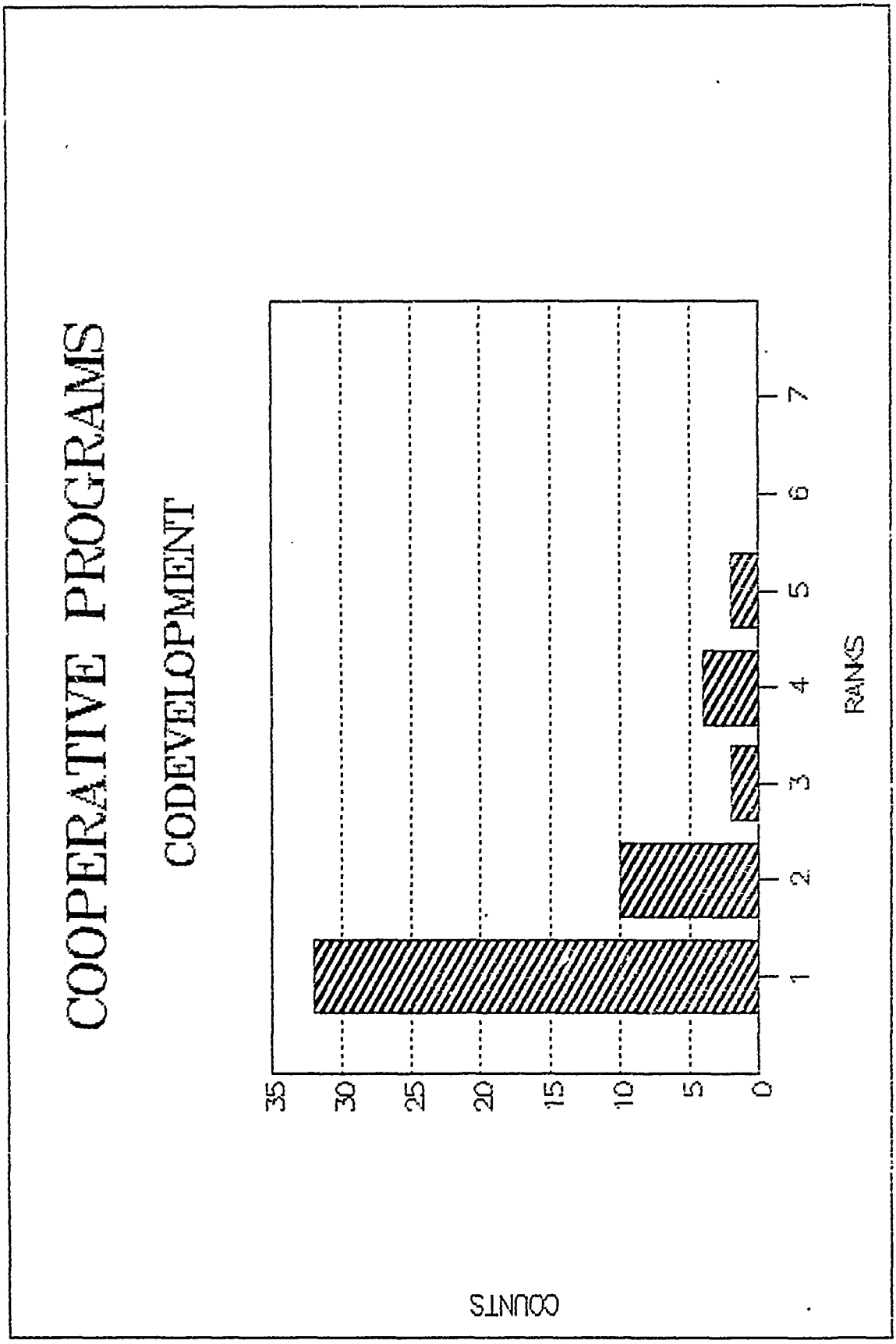
RANKS

CROSS SERVICING PROBLEM SOLUTIONS

COOPERATIVE PROGRAMS

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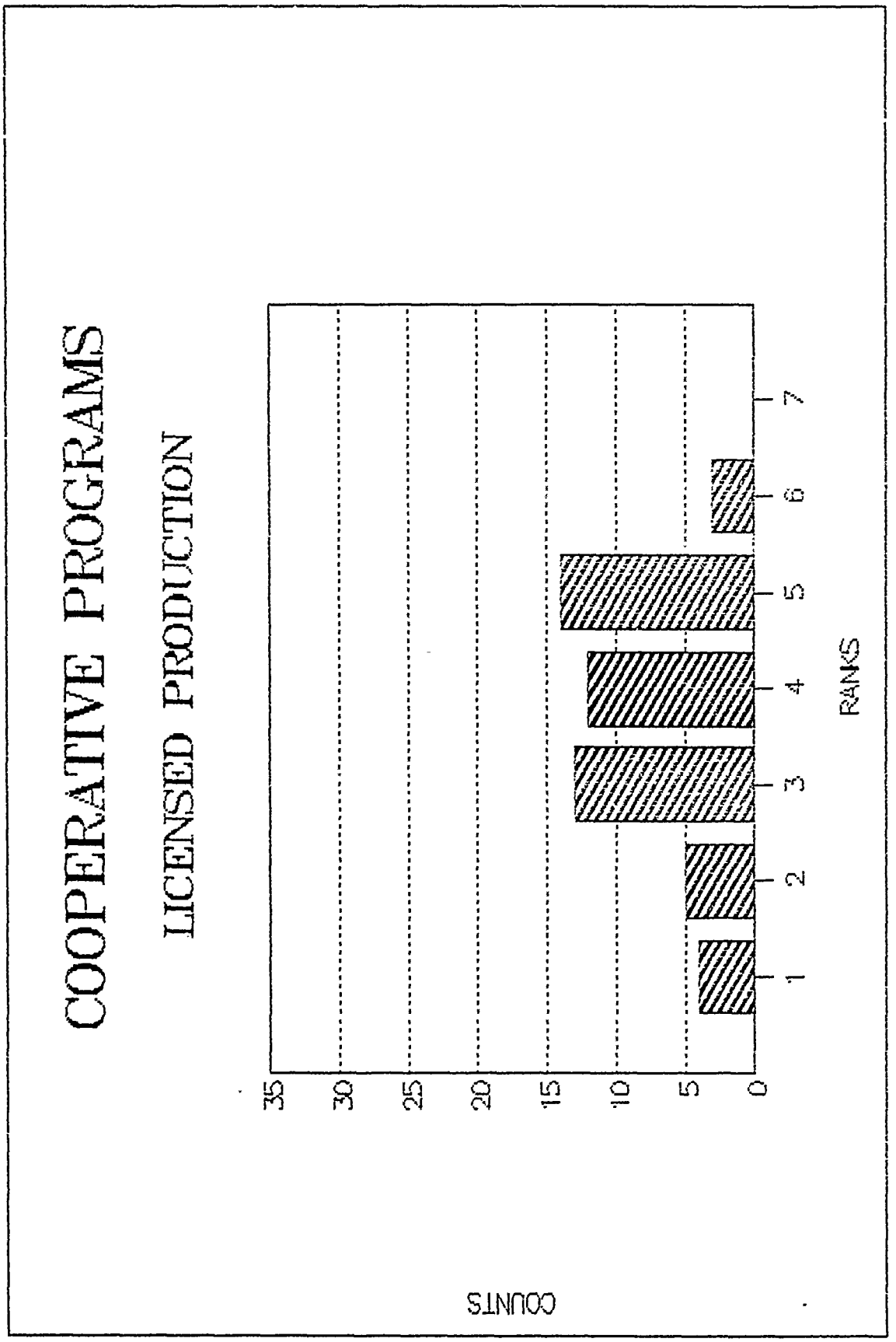
RANKS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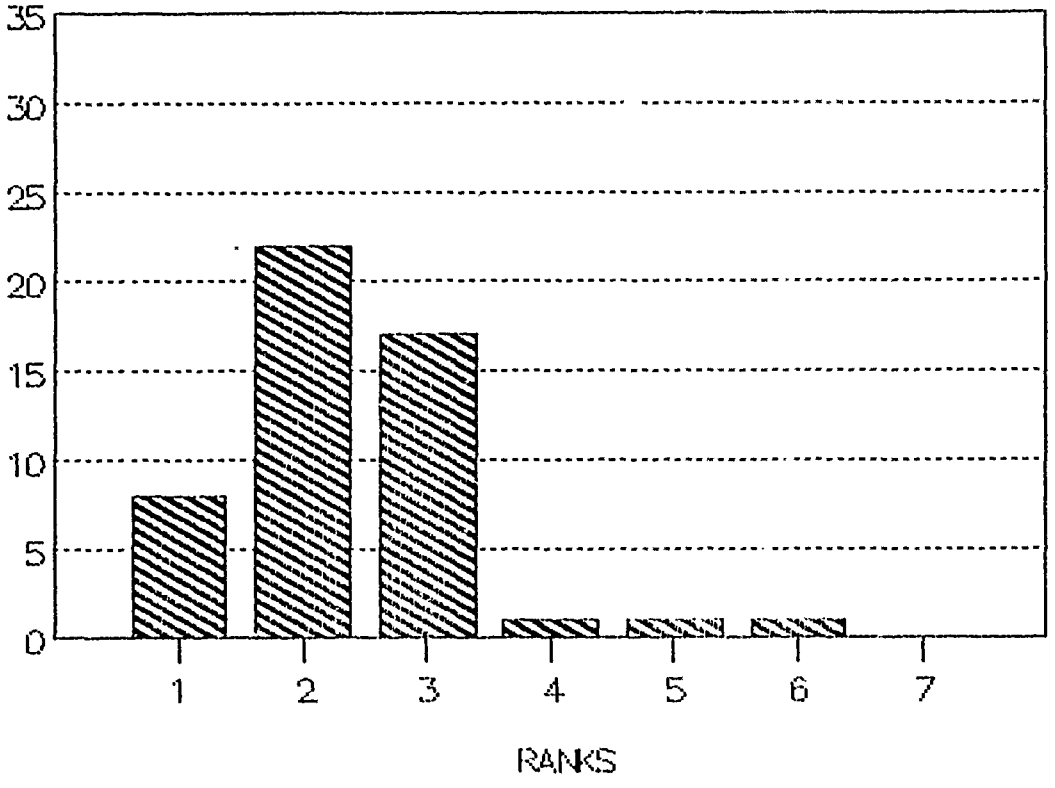
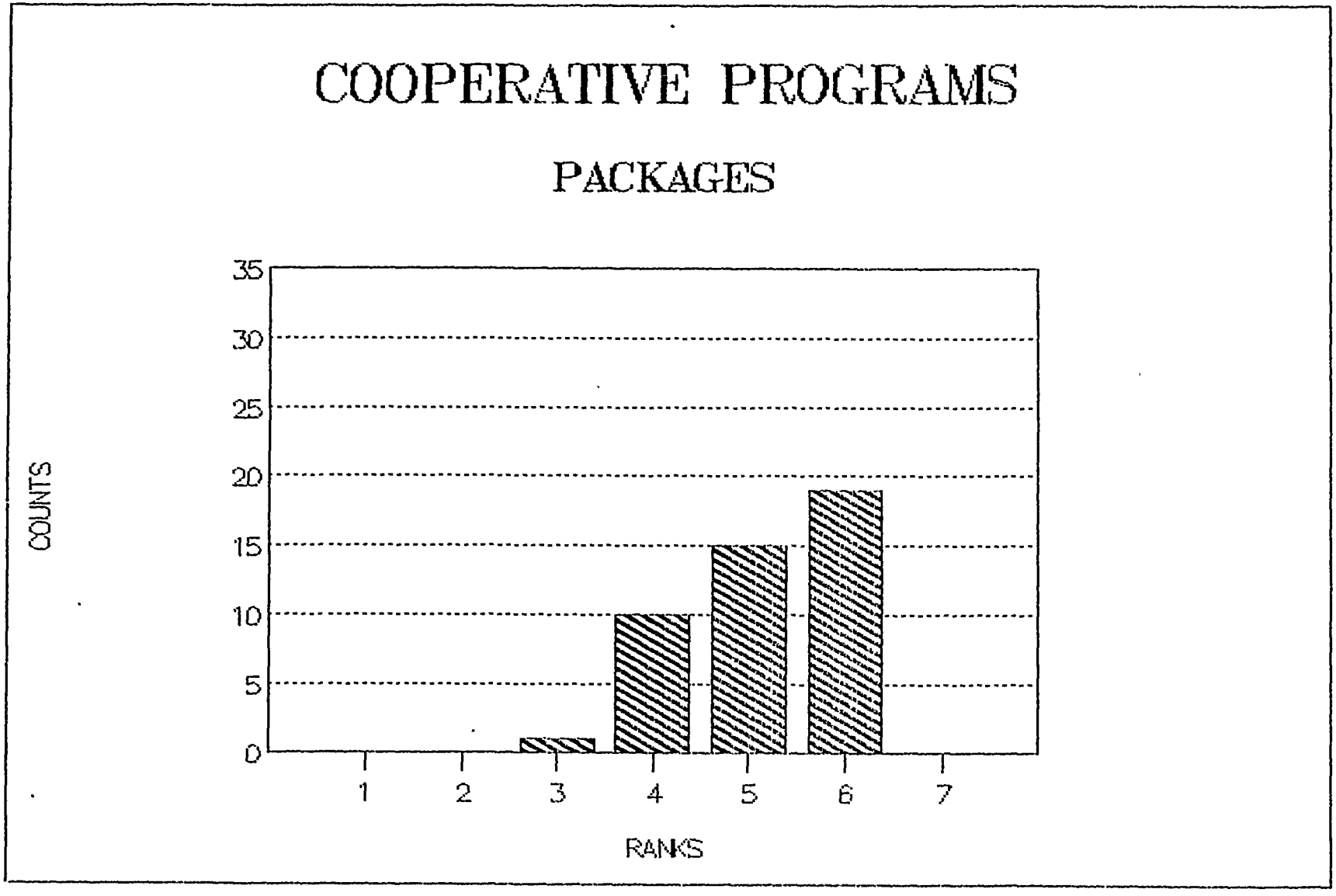
COOPERATIVE PROGRAMS

COPRODUCTION

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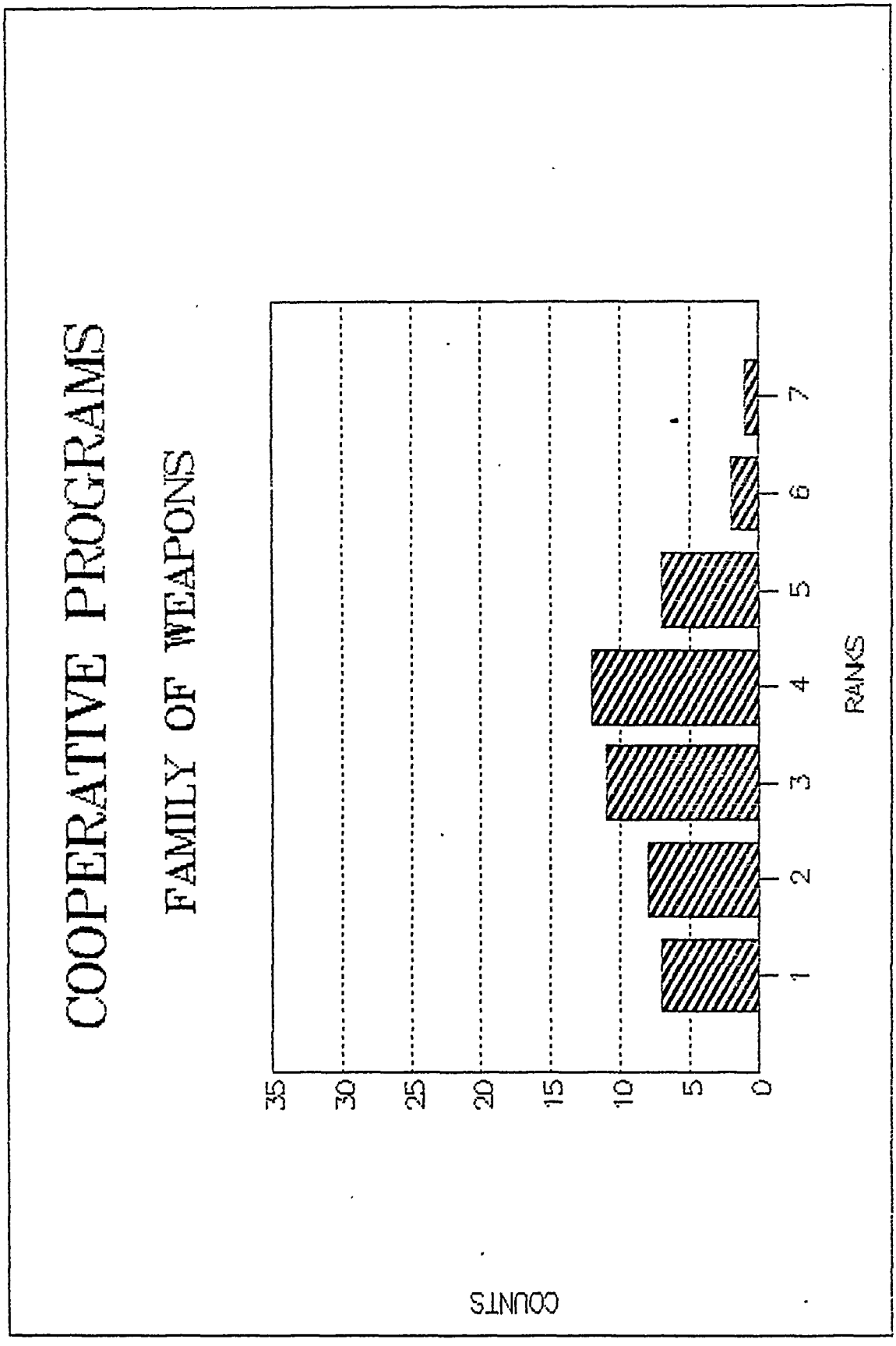
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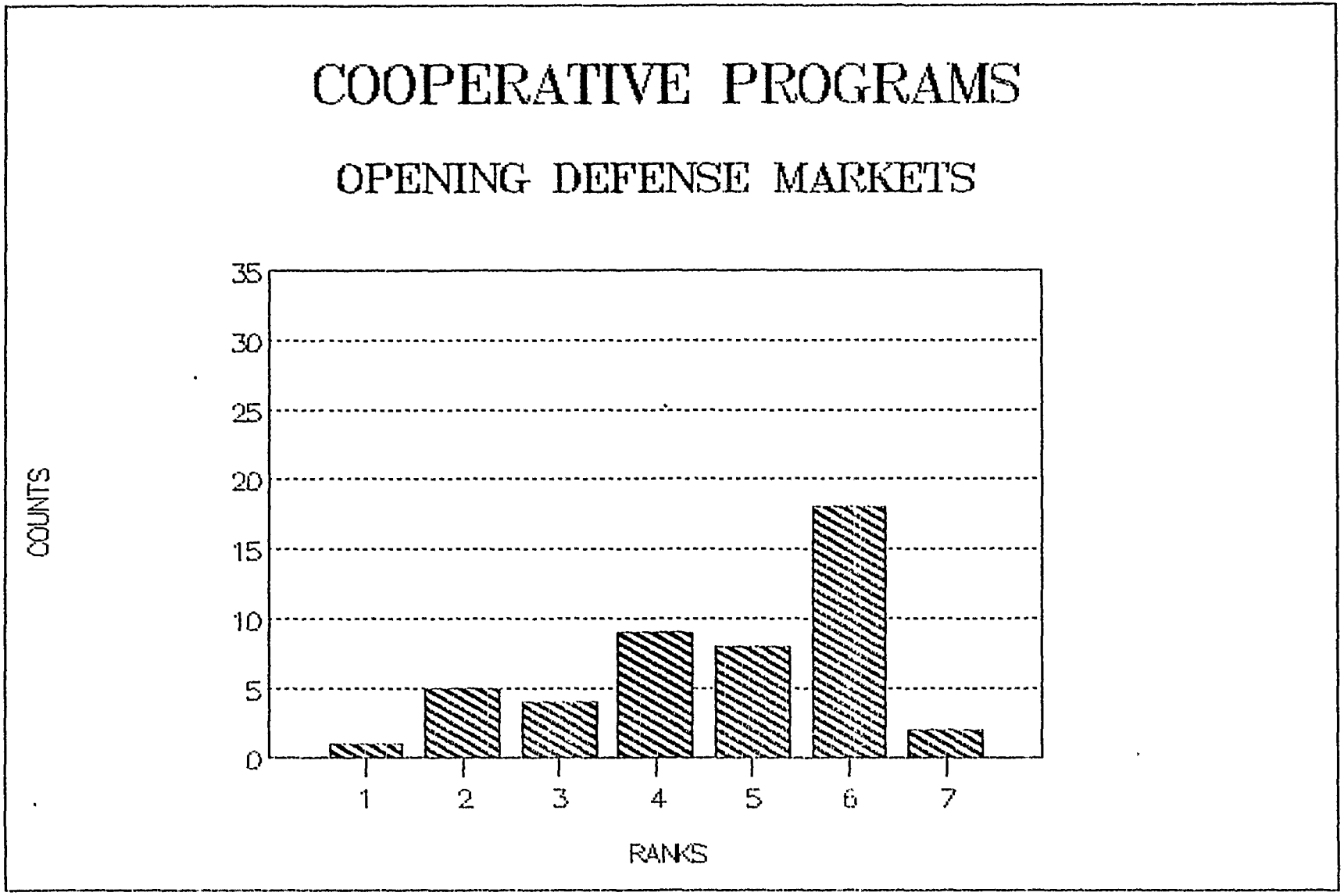
RANKS

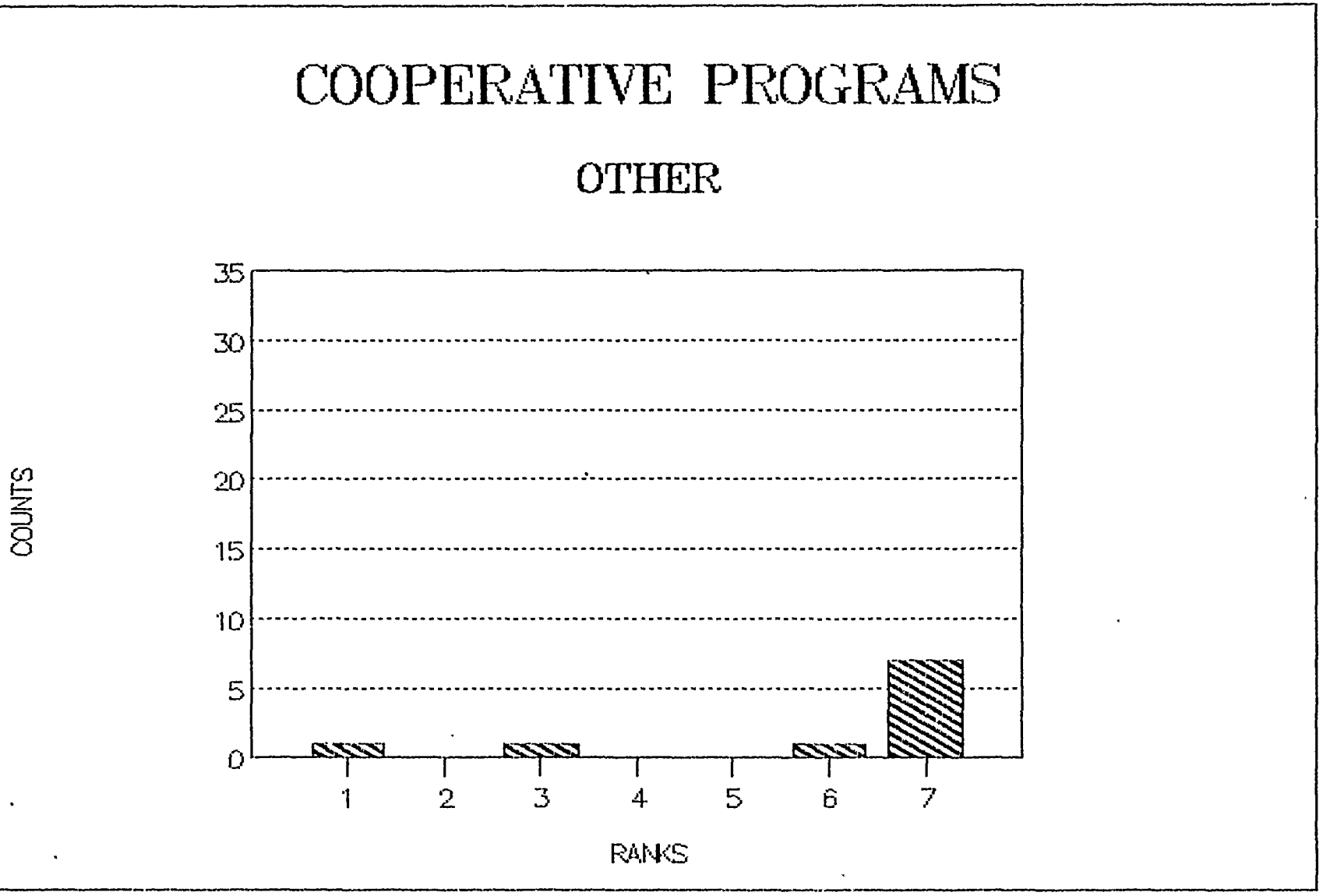
COOPERATIVE PROGRAMS

OPENING DEFENSE MARKETS



COOPERATIVE PROGRAMS

OTHER



CROSS SERVICING PROBLEM SOLUTIONS

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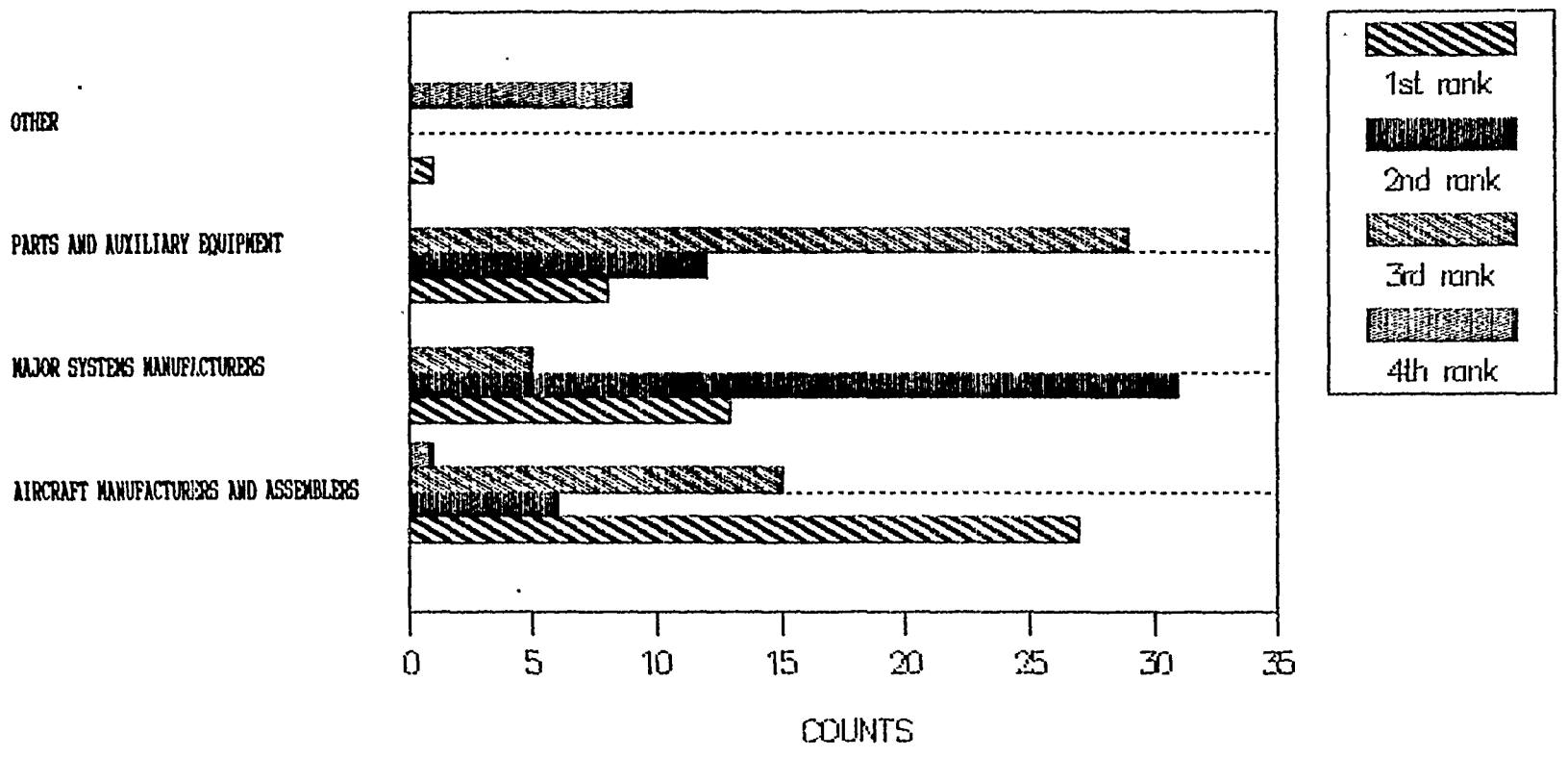

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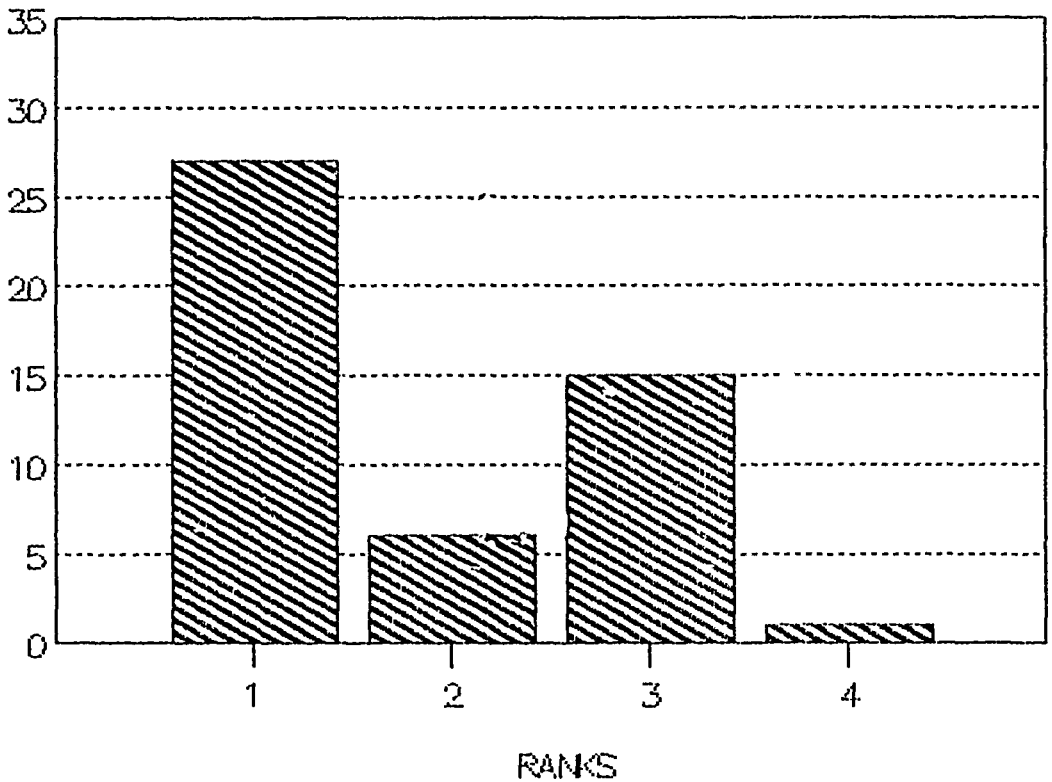

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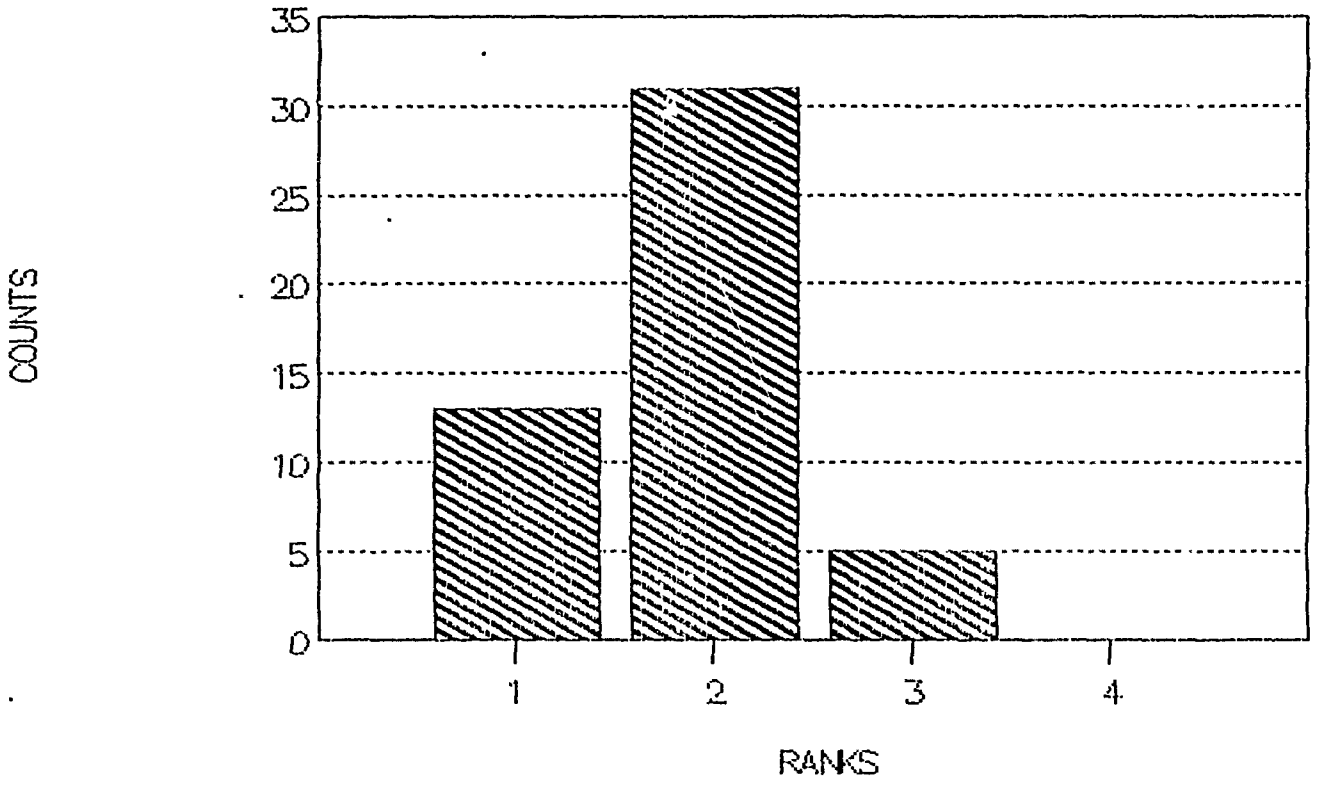

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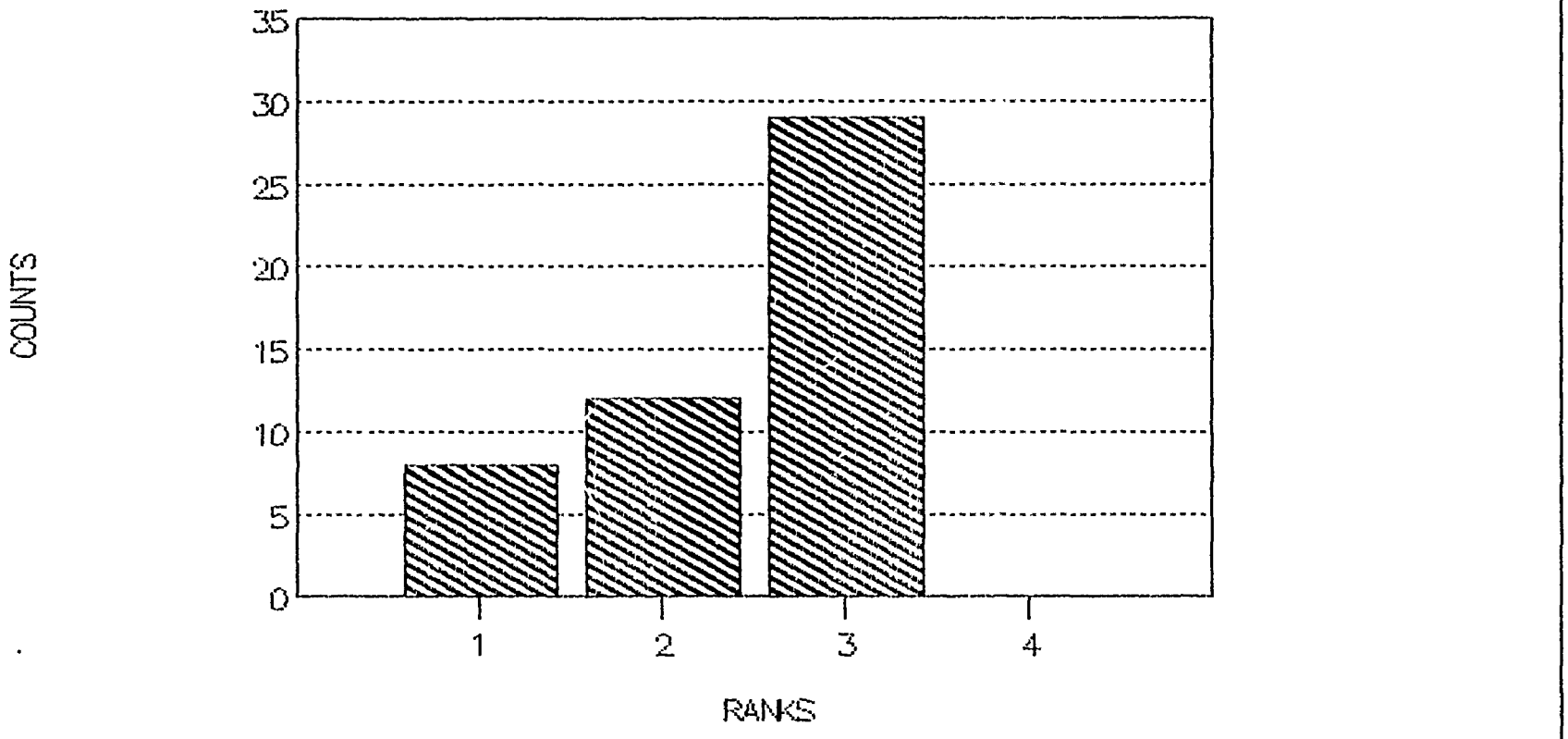

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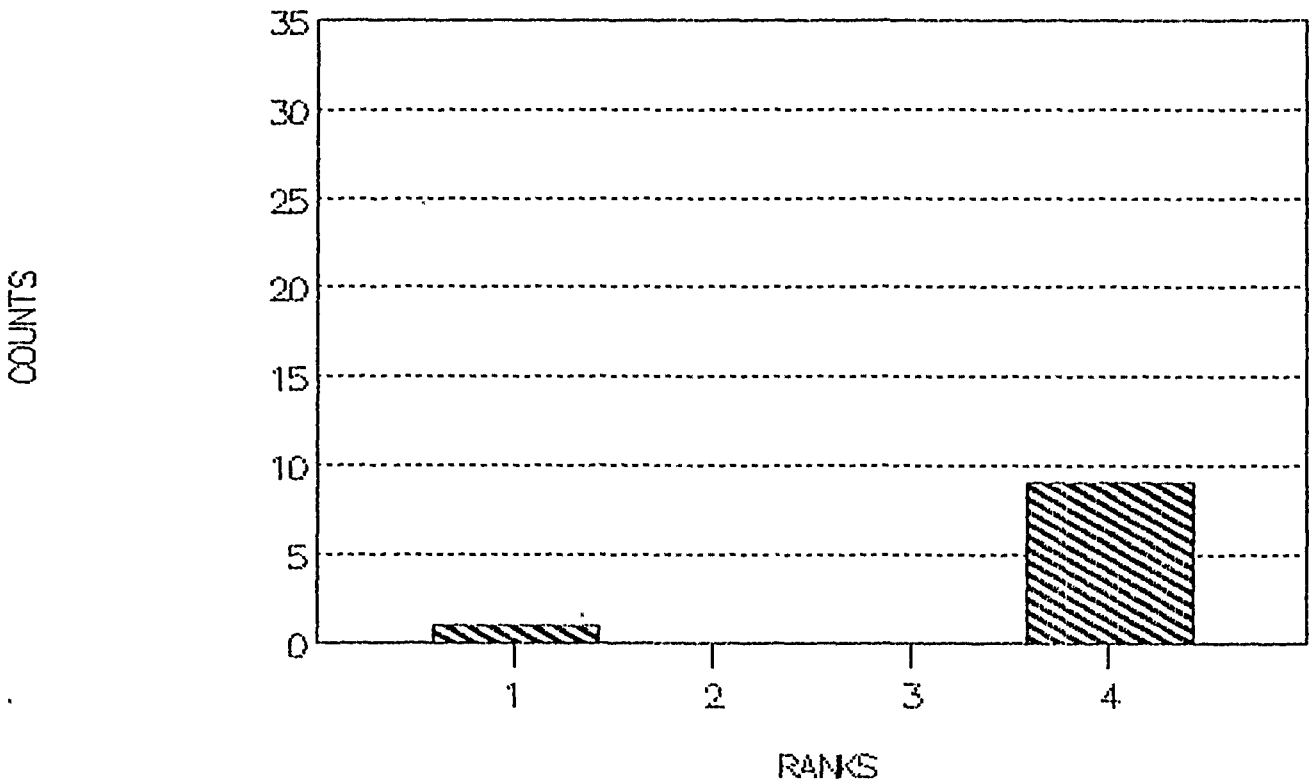

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4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GLM/LSM/89D-14	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION School of Systems & Logistics	6b. OFFICE SYMBOL (If applicable) AFIT/LSG
6c. ADDRESS (City, State, and ZIP Code) Air Force Institute of Technology Wright Patterson AFF OH 45433	7a. NAME OF MO[illegible] R[illegible]RGANIZATION 7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)
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10. SOURCE OF FUNDING NUMBERS			
PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

ENVIRONMENTAL EFFECTS UPON CROSS-SERVICING OF AIRCRAFT IN NATO

12. PERSONAL AUTHOR(S)

Juan A. del Castillo, Lt Col, SAF

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
MS Thesis	FROM _____ TO _____	1989 December	279

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	
15	01		NATO, Logistics, Interoperability, Cross-servicing

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Thesis Chairman: Craig M. Brandt
Associate Professor of International Logistics
Department of Logistics Management

Approved for public release: IAW AFR 190-1.

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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
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Cross-servicing of aircraft within NATO is a system established to provide services to aircraft by organizations other than those to which the aircraft are assigned. The ability to provide those services depends on the level of standardization and interoperability within the NATO alliance, and the present diversity of types of aircraft largely restricts the possibility to render those services. The system is regulated by the Standard Agreement 3430 under the field of responsibility of the Military Agency for Standardization (MAS).

New factors in the NATO political, economic, and military environment have arisen in the last few years, which added to already existing factors, have produced a situation of increased force requirements with reduced defense budgets and are forcing NATO planners to reassess the whole strategic planning within the alliance.

To determine the effects of the new environmental factors on the NATO logistics situation, thus on the diversity of types of aircraft and cross-servicing capabilities, a survey package was sent to the several organizations involved in the management of logistics throughout the alliance. The survey answers were statistically analyzed by regional areas, by continent, by organization, and by the condition of civilian or military of the respondents. The results were then summarized as conclusions for the research topic, but in the cases where the homogeneity tests were rejected this lack of homogeneity was a conclusion in itself as a causal factor explanatory for the lack of agreement responsible for the present situation of cross-servicing within the NATO alliance.

Thesis. (Jhd)